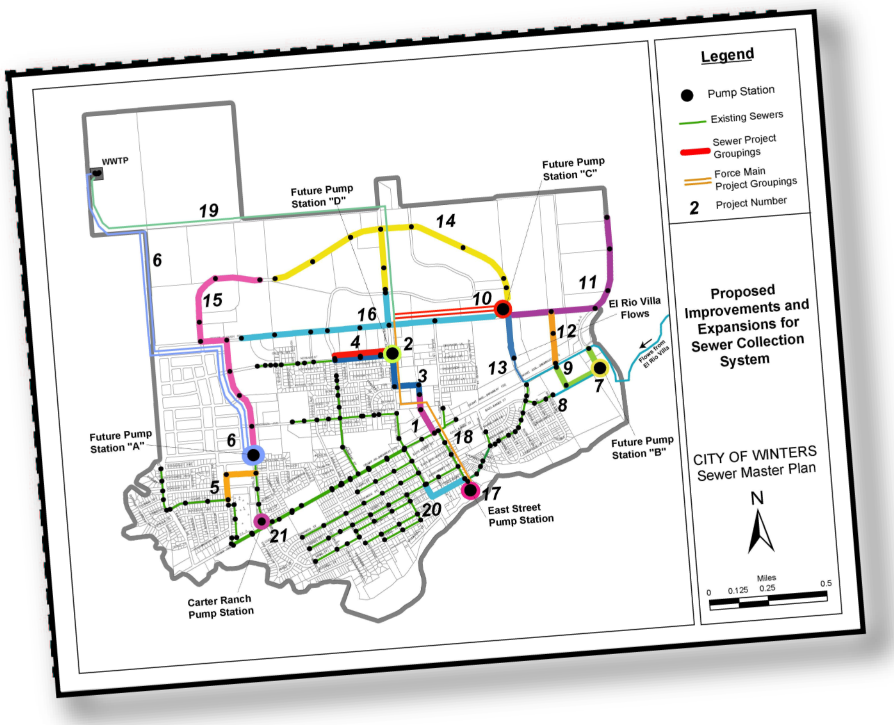
CITY OF WINTERS CALIFORNIA



Sewer Collection System Master Plan

December 2006

RMC
Water and Environment

RMC
Water and Environment

Los Angeles
Sacramento
San Francisco
San Jose
Walnut Creek

February 16, 2007

Mr. Nick Ponticello, P.E.
City Engineer
City of Winters
318 First Street
Winters, CA 95694

Subject: City of Winters Sewer Collection System Master Plan – Final

Dear Mr. Ponticello:

RMC Water and Environment is pleased to submit this Final Sewer Collection System Master Plan for the City of Winters, reflecting approval of the document by City Council on February 6, 2007. This Master Plan presents the comprehensive evaluation of the capacity of the City's sanitary sewer collection system and recommends sanitary sewer collection system improvement projects necessary to address the City's existing and future wastewater collection needs.

We greatly appreciate the support and guidance received from the City's engineering and operations staff throughout the study. Their input and contributions were critical in developing the recommendations presented in this Sewer Collection System Master Plan.

Sincerely,

Glenn E Hermanson

REGISTERED PROFESSIONAL ENGINEER
GLENN E. HERMANSON
No. 46659
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STATE OF CALIFORNIA

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Innovative Solutions for Water and the Environment

EXECUTIVE SUMMARY

This 2006 Sewer Collection System Master Plan is an update to the 1992 Sewer Master Plan (CH2M Hill, 1992). The 1992 Sewer Master Plan defined the sanitary sewer system improvements necessary to accommodate the City's future land use development plans based on the City's 1992 General Plan. In addition, the 1992 Sewer Master Plan addressed wastewater treatment and called for construction of a new, relocated wastewater treatment facility. In 1997, the City approved the "Revision to the Sewer System Master Plan – Wastewater Treatment Facilities, Final Report," as prepared by Larry Walker Associates, which provides for the expansion of the existing wastewater treatment facilities. This 2006 Sewer Collection System Master Plan does not address wastewater treatment facilities, but rather, supplements the "Revision to the Sewer System Master Plan – Wastewater Treatment Facilities, Final Report." Together, therefore, this 2006 Sewer Collection System Master Plan, along with the "Revision to the Sewer System Master Plan – Wastewater Treatment Facilities, Final Report," supercedes (i.e., replaces) the 1992 Sewer Master Plan.

The objectives of this 2006 Sewer Collection System Master Plan are fourfold:

1. To create a computerized hydraulic model of the sewer system using H_2OMAP Sewer Pro, Version 5.0;
2. To identify existing and future deficiencies within the existing sewer collection and pumping system network;
3. To master plan the future sewer collection system network for buildout expansion of the City within the urban service boundary; and
4. To update the Capital Improvement Program.

ES.1 Capital Improvement Program

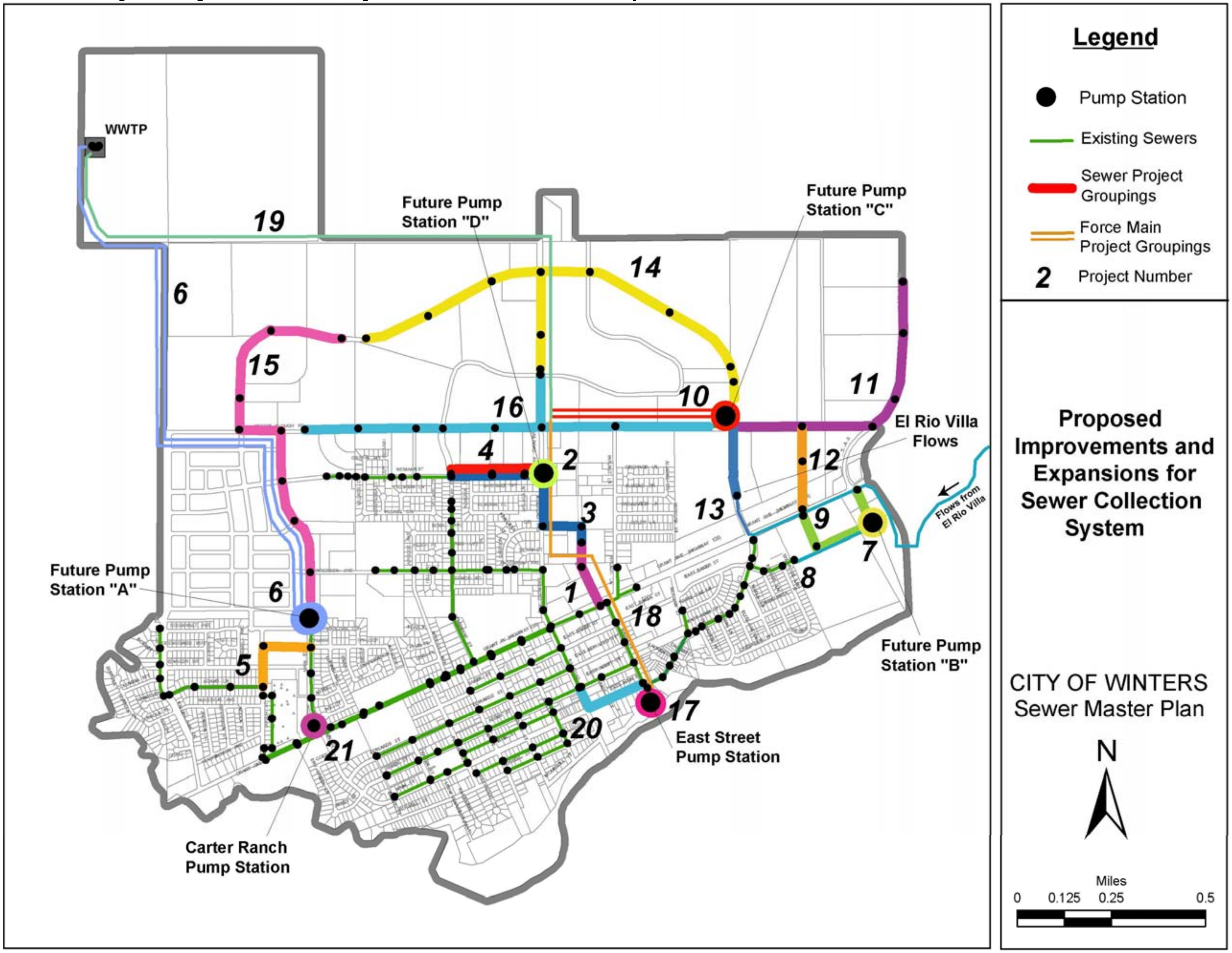
A summary of the sewer capital improvement projects that are recommended to correct potential wet weather conveyance and pumping capacity deficiencies under existing and future conditions is provided in Table ES-1 and shown in Figure ES-1.

Table ES-1: Summary of Capital Improvement Projects

PROJECT NO.	DESCRIPTION	FIRM CAPACITY [a] (gpm)	LENGTH (ft)	ESTIMATED CAPITAL COST [b]
Existing Capacity Deficiency Projects				
1	Dutton Street Sewer Upsize	---	950	$201,000
		Subtotal	***950***	***$201,000***
Proposed Pump Station Expansion Projects				
2	Pump (Lift) Station on Railroad Avenue	106	---	$465,000
6	Future Pump Station A for Southwest Area	1,240	---	$1,859,000
	Dual Force Mains from Future Pump Station A	---	16,100	$2,089,000
7	Future Pump Station B for Gateway Area	310	---	$930,000
8	Future Pump Station B Force Main	---	360	$37,000
10	Future Pump Station C for Northeastern Area	2,170	---	$2,832,000
	Dual Force Mains to Parallel E. Street PS Force Mains	---	5,200	$804,000
17	East Street Pump Station Expansion	3,160	---	$1,430,000
	East Street Pump Station Instrumentation Updates	---	---	$69,000
18	Parallel E. St. PS Force Main Segment #1	---	4,800	$1,030,000
19	Parallel E. St. PS Force Main Segment #2	---	10,100	$2,423,000
21	Carter Ranch PS Upgrade	125	---	$189,000
		Subtotal	***29,860***	***$14,156,000***
Future Collection System Expansion Projects				
3	Neimann/Railroad/Dutton Sewers	---	2,760	$341,000
4	Parallel Sewers on Neimann Street (to Pump Station D)	---	1,290	$160,000
5	Southwest Area Sewers	---	1,240	$154,000
9	Gateway Area Sewers	---	1,860	$230,000
11	Northeastern Area Sewers	---	4,350	$829,000
12	Timbercrest Road Sewers	---	1,200	$149,000
13	North Main Street Sewers	---	1,580	$196,000
14	Main Street Loop Sewers	---	8,040	$1,274,000
15	Eastern Main Street Sewers	---	6,280	$1,059,000
16	Moody Slough Sewers	---	9,330	$1,056,000
20	Railroad/East Abbey to Main Street Relief Sewer	---	1,175	$398,000
		Subtotal	***39,105***	***$5,846,000***
22	Master Plan Implementation and Management [c]			***$1,011,000***
		TOTAL	**69,915**	**$21,214,000**

[a] Firm capacity is the capacity of the pump station with the largest pump not operating.
[b] Rounded up to the nearest $1,000.
[c] Assume cost to be 5% of the total estimated capital cost for projects 1 through 21. A small portion of the cost includes additional engineering analysis for certain recommended projects.

Figure ES 1-1: Proposed Improvements and Expansions for Sewer Collection System



ES.2 Additional Recommendations

Following are the recommendations that were developed related to the other objectives of this Master Plan.

ES.2.1 H$_2$OMap Sewer System Hydraulic Model

The H$_2$OMap computer model should be updated periodically to reflect changes in the sewer system and updated flow information.

ES.2.2 Flow Monitoring Program

It is recommended to conduct a system-wide dry and wet weather temporary flow monitoring program to:

- refine the dry weather sewage generation factors for various land use categories;
- evaluate groundwater infiltration (GWI) and rainfall-dependent inflow/infiltration (RDI/I) rates;
- develop diurnal variation curves for different land use categories;
- develop the shape of the wet weather response hydrograph for different areas of the City;
- calibrate the model under fully dynamic conditions; and
- refine the system capacity analysis and recommended capital improvement projects

Refining the model with flow data could reduce the number or extent of the recommended sewer capacity improvement projects. The cost of a dry and wet weather flow monitoring program including dynamic modeling and refining the capital improvement projects would range between $60,000 and $90,000. If the instrumentation upgrade is performed before the flow monitoring is started, the cost of the flow monitoring program could be reduced.

ES.2.3 East Street Pump Station and Force Main Evaluation

The East Street Pump Station (ESPS) and Force Main (ESFM) are critical components of the City's infrastructure. Currently, 100 percent of the City's sewage is pumped by the ESPS and conveyed by the ESFM. The pump station and force main were constructed in 1979 and the end of the useful life of some mechanical components is approaching. Even though the City did upgrade some of the electrical components at the ESPS several years ago, a detailed evaluation, including condition assessment and hydraulic analysis, of the ESPS and ESFM will allow proper planning for replacement or rehabilitation, as necessary. As part of the hydraulic analysis, a temporary pressure gauge will need to be installed for the ESFM at a location near the Wastewater Treatment Facility. This evaluation should be performed after the ESPS Instrumentation Upgrade Project (Project 17) and prior to the ESPS expansion.

ES.2.4 Force Main Rupture Plan(s)

A detailed Force Main Rupture Plan is recommended for the East Street Force Main, as well as the force mains from other recommended future pump stations. The development of force main rupture plans will reduce or eliminate the impacts of a sewage spill if a rupture were to occur. Ruptures in force mains are events that may occur for a variety of reasons, the most common of which is being accidentally broken by a contractor excavating in the vicinity of the force main.

ES.2.5 Sewer System Management Plan (SSMP)

Historically, Winters has relatively few sewer overflows. Sewer overflows can be caused by many factors including, root clogs, grease clogs, broken pipes, wet weather infiltration, pump station mechanical failure, vandalism, illegal disposal of wastes, and power failures. State regulators have recently adopted a statewide Waste Discharge Requirement (WDR) that will require all collection system agencies to prepare a Sewer

System Management Plan. Because of the broad range of factors that cause overflows, the WDR is also broad and regulates aspects of capacity, management, operations, and maintenance, or CMOM for short. Winters should proactively meet the requirements of the SSMP.

ES.2.6 MISCELLANEOUS

- Uncover manholes that are paved over on Grant Avenue.
- Survey the invert elevations of SP-1290 on Grant Avenue. See Section 5.1.2.1 for more discussion.
- Reconfigure manholes MH-2192 on Neimann Street and Hemenway Street and MH-2094 on Taylor Street. See Section 5.1.2.4 for more discussion.
- Implement a cleaning and televising inspection program of sewer lines.

ACKNOWLEDGEMENT

The 2006 Sewer Collection System Master Plan represents a collaborative effort between RMC and the City of Winters. We would like to acknowledge and thank the following key personnel from the City whose invaluable knowledge, experience, and contributions were instrumental in the preparation of this Master Plan.

John Donlevy, Jr. – City Manager
Charles Simpson – Director of Public Works
Karen Honer – Director of Public Works (former)
Nicholas Ponticello – City Engineer, Ponticello Enterprises Consulting Engineers, Inc.
Alan Mitchell – Project Manager, Ponticello Enterprises Consulting Engineers, Inc.
City Operations/Field Staff

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ABBREVIATIONS

ADWF	average dry weather flow
BWF	base wastewater flow
CCI	construction cost index
cfs	cubic feet per second
CIP	capital improvement project
City	City of Winters
DU	dwelling unit
ENR	engineering news record
ESPS	East Street pump station
ESFM	East Street force main
ft	feet
ft/s	feet per second
FY	fiscal year
gal	gallon
GIS	geographical information system
gpd	gallons per day
gpd/person	gallons per day per person
gpd/acre	gallons per day per acre
GWI	groundwater infiltration
in	inch
I/I	infiltration and inflow
LF	linear feet
MG	million gallons
MGD	million gallons per day
NA	not applicable
PDWF	peak dry weather flow
PF	peaking factor
PS	pump station
PWWF	peak wet weather flow
RDI/I	rainfall dependent infiltration and inflow
sqft	square feet
TM	technical memorandum
WWTF	wastewater treatment facilities

CHAPTER 1 INTRODUCTION

Chapter Synopsis: This chapter presents the purposes, objectives, and scope for the 2006 Sewer Collection System Master Plan. It also summarizes previous sewer master plans and studies prepared by the City that are pertinent to the sanitary sewer system.

This 2006 Sewer Collection System Master Plan is an update to the 1992 Sewer Master Plan (CH2M Hill, 1992). The 1992 Sewer Master Plan defined the sanitary sewer system improvements necessary to accommodate the City's future land use development plans based on the City's 1992 General Plan. In addition, the 1992 Sewer Master Plan addressed wastewater treatment and called for construction of a new, relocated wastewater treatment facility. In 1997, the City approved the "Revision to the Sewer System Master Plan – Wastewater Treatment Facilities, Final Report," as prepared by Larry Walker Associates, which provides for the expansion of the existing wastewater treatment facilities. This 2006 Sewer Collection System Master Plan does not address wastewater treatment facilities, but rather, supplements the "Revision to the Sewer System Master Plan – Wastewater Treatment Facilities, Final Report." Together, therefore, this 2006 Sewer Collection System Master Plan, along with the "Revision to the Sewer System Master Plan – Wastewater Treatment Facilities, Final Report," supercedes (i.e., replaces) the 1992 Sewer Master Plan.

The City of Winters (City) is located in the southwestern corner of Yolo County, immediately north of the Solano County line and just east of the Vaca Mountain range. As shown in **Figure 1-1**, the City lies approximately 34 miles west of the state capital, Sacramento, and approximately 10 miles north of Vacaville. The City is bordered on the south by Putah Creek, which has a year round flow emanating from Monticello Dam 9 miles to the west. Monticello Dam backs up Lake Berryessa and is a major recreation area, drawing tourists from the San Francisco Bay Area and elsewhere.[1]

Figure 1-1: City of Winters Location

The settlement of the Winters area began in 1842 on the south side of Putah Creek. In 1875, the Vaca Valley Railroad Company sought financial assistance from Theodore Winters and others to build a railroad bridge across Putah Creek to extend their line to the north bank of the Creek. In the process, the Railroad Company laid out a forty acre town, named it for Theodore Winters, and thus created the City of Winters.[1]

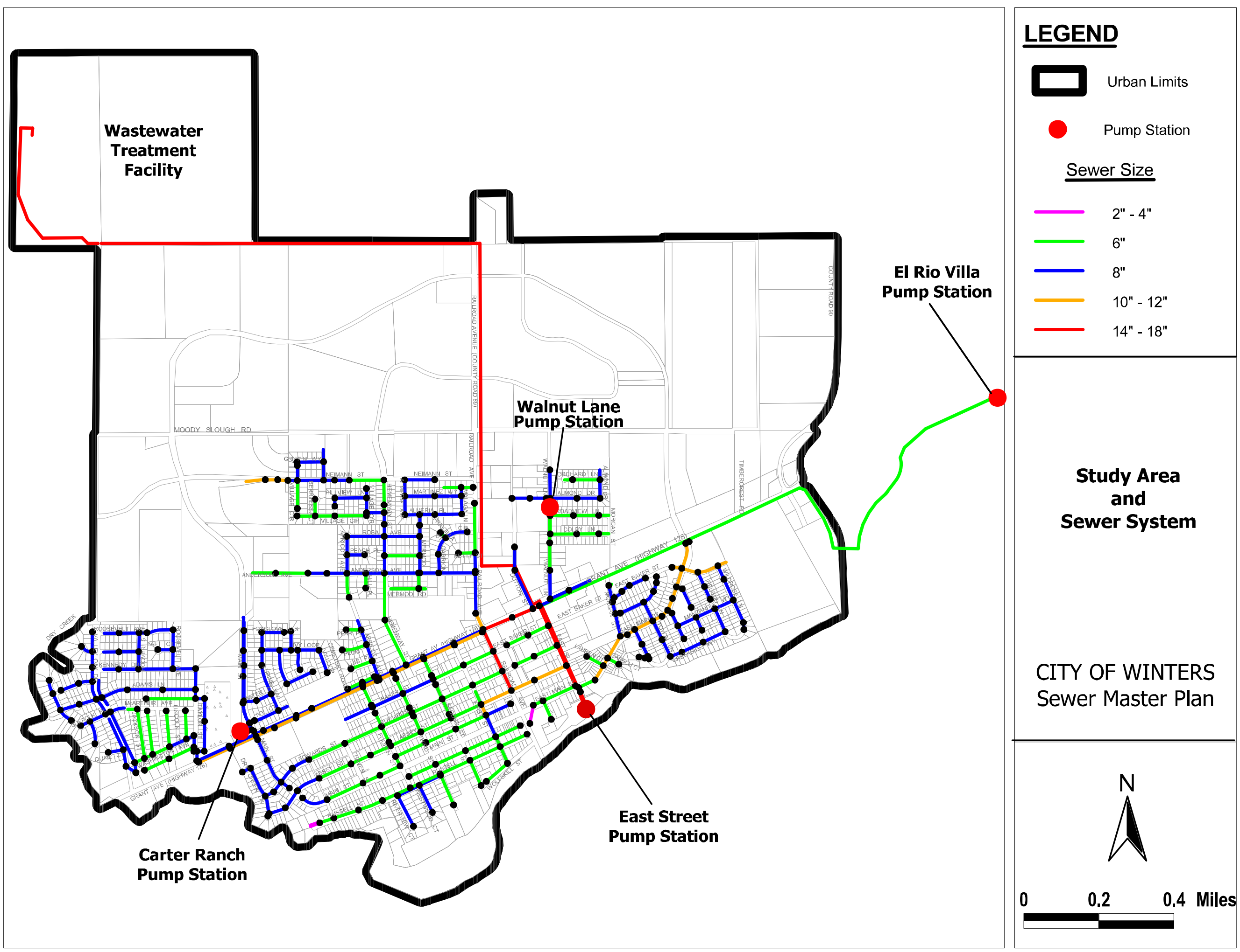
The area studied by this Master Plan effort is the City's urban limit area shown in Figure 1-2. The urban limit boundary is defined based on the 1992 General Plan and subsequent General Plan amendments.

[1] Excerpted and summarized from the City of Winters website at http://www.cityofwinters.org/

The City's sanitary sewer system collects the wastewater flows from approximately 1,980 acres within the City planning area and El Rio Villa, a small subdivision located approximately 0.7 miles east and outside of the City's urban limit boundary. Within the urban limit boundary, the City's sewer collection system serves a population of approximately 7,300 people through approximately 136,620 linear feet (LF) of sewers.[2] **Figure 1-2** shows the alignment, size of sewers, and location of the three pump stations that make up the City's existing sewer collection system. The El Rio Villa Pump Station (PS) and force main are owned by the Yolo County Housing Authority and maintained by the City through a 1979 maintenance/use-agreement.

Currently, all of the City's wastewater flows are conveyed to the East Street Pump Station (ESPS). Wastewater flows generated by the El Rio Villa subdivision are conveyed to the ESPS via the El Rio Villa PS and force main. The ESPS, in turn, pumps all the flow collected northward to the Wastewater Treatment Facility (WWTF) through a 14-inch force main. The Carter Ranch Pump Station shown in Figure 1-2 is a relatively new pump station. This pump station was constructed to convey future flows from the Carter Ranch subdivision northward to a future collection facility. Currently, all flows from the Carter Ranch area are pumped to the gravity sewer on Grant Avenue. The Walnut Lane Pump Station pumps flows from the Almond Ranch subdivision.

Figure 1-2: Master Plan Study Area and the City's Sewer Collection System



[2] According to the State Department of Finance (http://www.dof.ca.gov/HTML/DEMOGRAP/E-1text.htm), Winters Population estimate for 2006 is 7,300. The approximate lineal feet of sewer were calculated based on GIS information.

1.1 Project Purpose

This Master Plan is an update and re-evaluation of the 1992 Sewer Master Plan (CH2M Hill, 1992) and provides information required for the City planning and financial efforts. The 1992 Sewer Master Plan defined the sanitary sewer system improvements necessary to accommodate the City's future land use development plans based on the City's 1992 General Plan. However, not all of the sewer capacity improvements recommended in the 1992 Sewer Master Plan Update have been implemented (see Figure 1-4), and new land use development/amendment patterns for the City have since been defined that could stress the system beyond the 1992 assumptions.

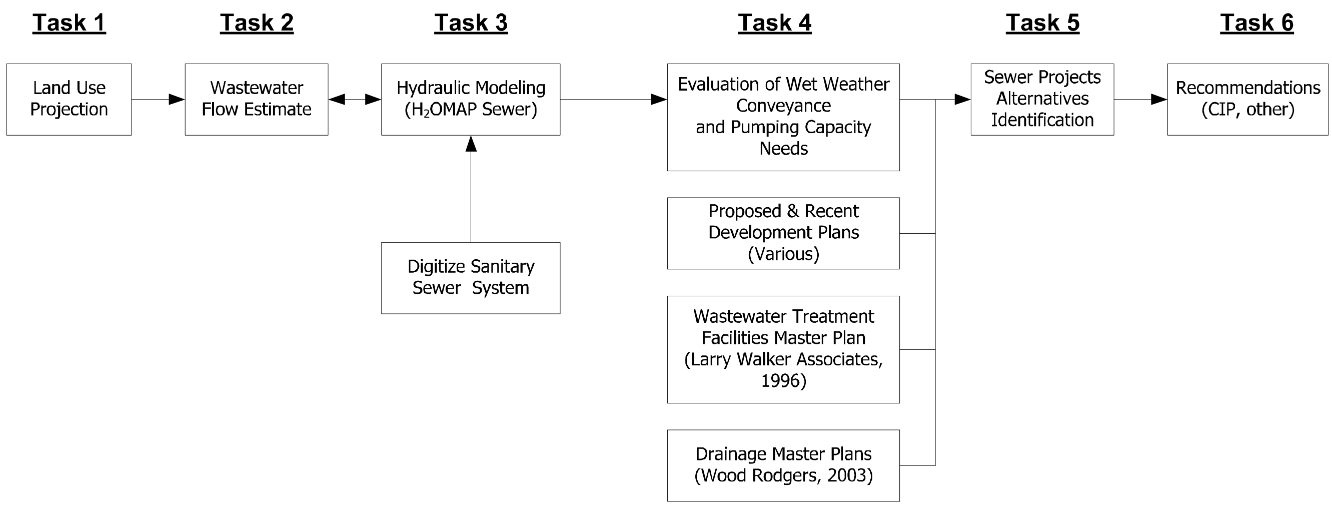
1.2 Objectives and Scope

The objectives of this revised 2006 Sewer Collection System Master Plan are fourfold:

1. To create a computerized hydraulic model of the sewer system using H_2OMAP Sewer Pro, Version 5.0;
2. To identify existing (September 2002) and future deficiencies within the existing sewer collection and pumping system network;
3. To master plan the future sewer collection system network for buildout expansion of the City within the urban service boundary; and
4. To update the Capital Improvement Program.

To achieve these objectives, the scope of work was divided into six tasks as shown in **Figure 1-3**. Tasks 1 through 6 are discussed in Chapters 2 through 7 of this report, respectively.

Figure 1-3: Master Plan Flowchart



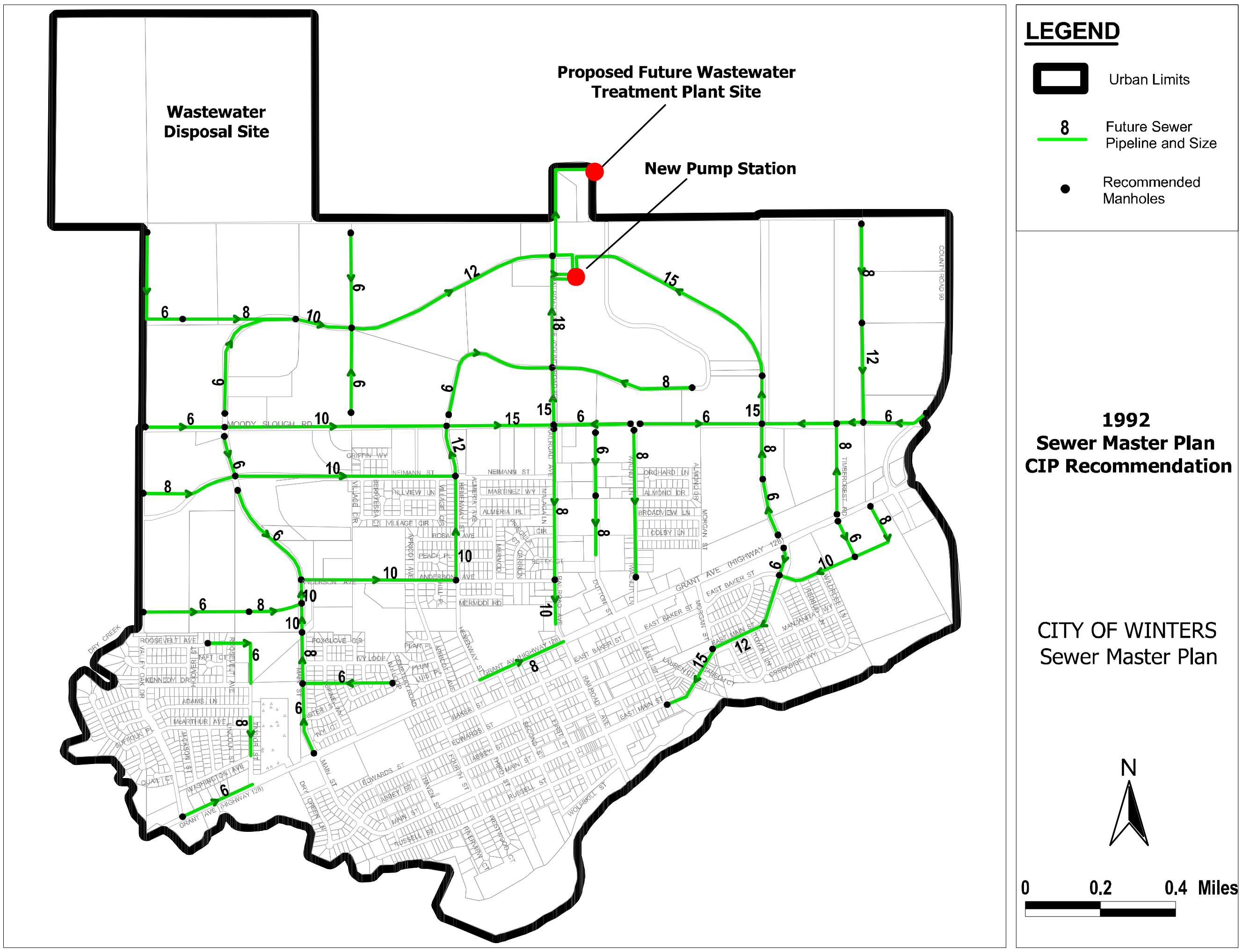
1.3 Previous Studies

The City had previously prepared a master plan for the sanitary sewer system in 1992. Since then, there have been various supplemental master plan studies for proposed expansions to the sewer collection system, including the Gateway, Greyhawk, Winters Highland, and Callahan Developments. Recently, the City also completed two planning studies pertinent to this Master Plan: 1) Draft Moody Slough Subbasin Drainage Master Plan, and 2) Draft Putah Creek, Dry Creek Subbasins Drainage Master Plan.

1.3.1 SEWER MASTER PLAN

The 1992 master planning effort conducted by CH2M Hill developed a capital improvement program to accommodate the City's future land use development plans to the year 2010. **Figure 1-4** shows the location of the 1992 Sewer Master Plan recommended projects.

Figure 1-4: 1992 Sewer Master Plan Recommended Projects



Source: CH2M Hill, 1992

1.3.2 OTHER CITY STUDIES

As part of this Master Plan, the consultant team also reviewed two studies that the City recently completed to identify potential multipurpose projects.

1.3.2.1 Gateway, Greyhawk, Winters Highland, and Callahan Developments

Utility plans for these proposed developments were reviewed to ensure that all alternatives were considered prior to developing the recommended future sewer collection system master planned facilities.

1.3.2.2 Moody Slough, Putah Creek, and Dry Creek Subbasins Drainage Master Plans

The Drainage Master Plans were completed in June and July 2005 (Draft versions) by Wood Rodgers. The studies included the identification of "phased drainage master planned facilities to mitigate increases to existing flooding problems and accommodate proposed development" within three major drainage subbasins within the City. The Draft Drainage Master Plans were reviewed to ensure that the elevation and alignment of the recommended sewer collection system master planned facilities would not conflict with the drainage master planned facilities.

1.4 Report Content

This report is divided in six chapters, as outlined below:

- CHAPTER 1 – INTRODUCTION (this introduction)
- CHAPTER 2 – LAND USE, describes the available land use databases and discusses existing and future land use data to be used in Chapter 3.
- CHAPTER 3 – HYDRAULIC MODEL DEVELOPMENT, presents the model development, the basis for sanitary flow projections for the City based on land use information from Chapter 2, and calibration process.
- CHAPTER 4 – SEWER COLLECTION DESIGN CRITERIA, summarizes the design criteria used in the evaluation of hydraulic adequacy of existing facilities, and for establishing the alignment and size of future facilities.
- CHAPTER 5 – SEWER SYSTEM ANALYSIS & RECOMMENDATION, summarizes the wet weather conveyance and pumping needs identified using the hydraulic model developed in Chapter 4.
- CHAPTER 6 – CAPITAL IMPROVEMENT COSTS, presents the estimated costs for recommended CIP projects based on the analysis conducted in Chapter 5.

This report also contains five appendices.

APPENDIX A – DETAILED CIP COST ESTIMATE INFORMATION
APPENDIX B – GIS & H2OMAP SEWER FILES AND MISCELLANEOUS MODELING INFORMATION
APPENDIX C – H2OMAP WATER FILES (COMPUTER MODEL OF FORCE MAINS) AND MISCELLANEOUS FORCE MAIN MODELING INFORMATION
APPENDIX D – EAST STREET PUMP STATION PUMP CURVES
APPENDIX E – FORCE MAIN VALVING CONFIGURATIONS
APPENDIX F – CD CONTAINING FINAL REPORT AND ALL APPENDICES

CHAPTER 2 LAND USE

Chapter Synopsis: The identification of the most appropriate land use database and the evaluation of the existing and future land use scenarios are critical tasks when embarking on the sewer collection system master planning process. It is the key for developing the existing and future base wastewater flow component of the wastewater flow.

This section provides a summary of the land use databases that were considered and presents the existing (as of September 2002) and buildout land use estimates that were used for developing the 2006 Sewer Collection System Master Plan.

2.1 Land Use Database

The methodology used to generate base wastewater flows in H_2OMap Sewer included using Arcview to populate flow from individual parcels based on land use categories. H_2OMap Sewer was then used to link each parcel to its loading manhole. This method makes it easy to modify local land use designations and evaluate the impact on base wastewater flow generation and conveyance capacity needs. The parcel land use maps and databases were developed by incorporating the following information:

- Yolo County geographical information system (GIS) parcels shapefile/layer. The horizontal projection, in feet, for this shapefile and Sewer Collection System Master Plan project is California State Plan Zone II, NAD 83.
- City of Winters Zoning Map dated June 2003
- Orthorectified aerial photo of the City flown on September 5, 2002
- City of Winters General Plan
- Tentative Map and Preliminary Utility Plans for Winters Highland and Callahan Developments dated November 2003.

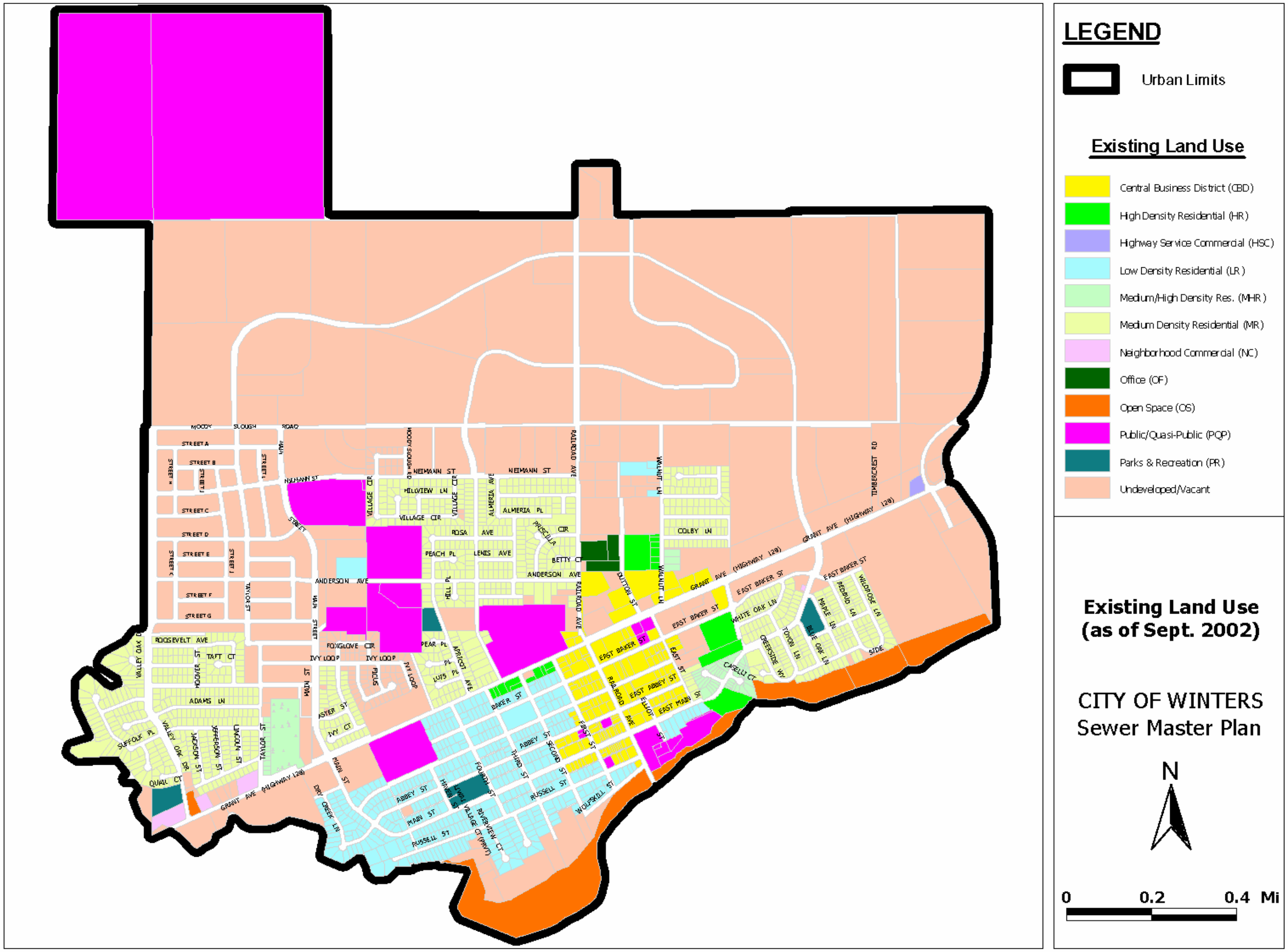
The Yolo County GIS parcel layer was used as a basis to import land use based wastewater flow information (including parcel acreage, land use type and characteristics) into the hydraulic model (see Chapter 3). It was necessary to develop the linkage between the parcel database (i.e. the parcel centroids) and the sanitary sewer system (i.e. nodes/manholes) in order to import the data. By using the City's sanitary sewer collection system atlas and record drawing information, the parcel centroids were linked to the nearest manhole or node in the model. The City's engineering staff provided input and reviewed the linkage. This parcel-manhole linkage is shown in Figure 3-3.

2.2 Existing and Future Land Use

Land use information per parcel is used in combination with unit base wastewater flow factors (sewage generation factors) to distribute sanitary flows in the sewer system hydraulic model. Unit base wastewater flow factors are usually expressed in gallon per day per net acre or per person and vary with the type of land use.

A list of land use categories was developed to reflect existing and future land uses with similar wastewater flow generation characteristics. This classification is based on the General Plan land use and zoning designations. A total of 18 land use categories were identified. The resulting existing land use map is presented in **Figure 2-1**; the database for existing and future land use maps are available in electronic format in Appendix B.

Figure 2-1: Existing Land Use Map



The following information was combined to create the land use database:

- **Parcel Layer** – The City of Winters' parcel layer was extracted from the Yolo County parcel shapefile and used as a base for developing the land use map.
- **Tentative Maps for Winters Highland and Callahan Developments** – These tentative maps were overlaid on the parcel layer to transfer planned roadway and block designations onto the parcel maps.
- **Zoning Map -** The zoning map provided by the City was overlaid on the parcel map using ArcView GIS Version 3.1 to transfer planned roadway information for vacant parcels at the north end of the City from the Zoning Map to the parcel layer. Some manual adjustments were required, as the zoning map did not overlay exactly on the parcel map. Next, the land use information was created as an attribute of the parcels and zoning designations were transferred to the parcel map as land use categories for the future/buildout scenario. The existing land use map was then created manually using additional information listed below.
- **Orthorectified Aerial Photo** – The 2002 citywide aerial photo was overlaid on the land use map to identify undeveloped/vacant and under developed areas.
- **General Plan -** The General Plan was used to identify possible areas where the actual land use differs from the zoning information.
- **City Input** - City staff identified and characterized the public-quasi-public (PQP) land use areas.

The buildout land use map is presented in **Figure 2-2**.

Figure 2-2: Buildout Land Use

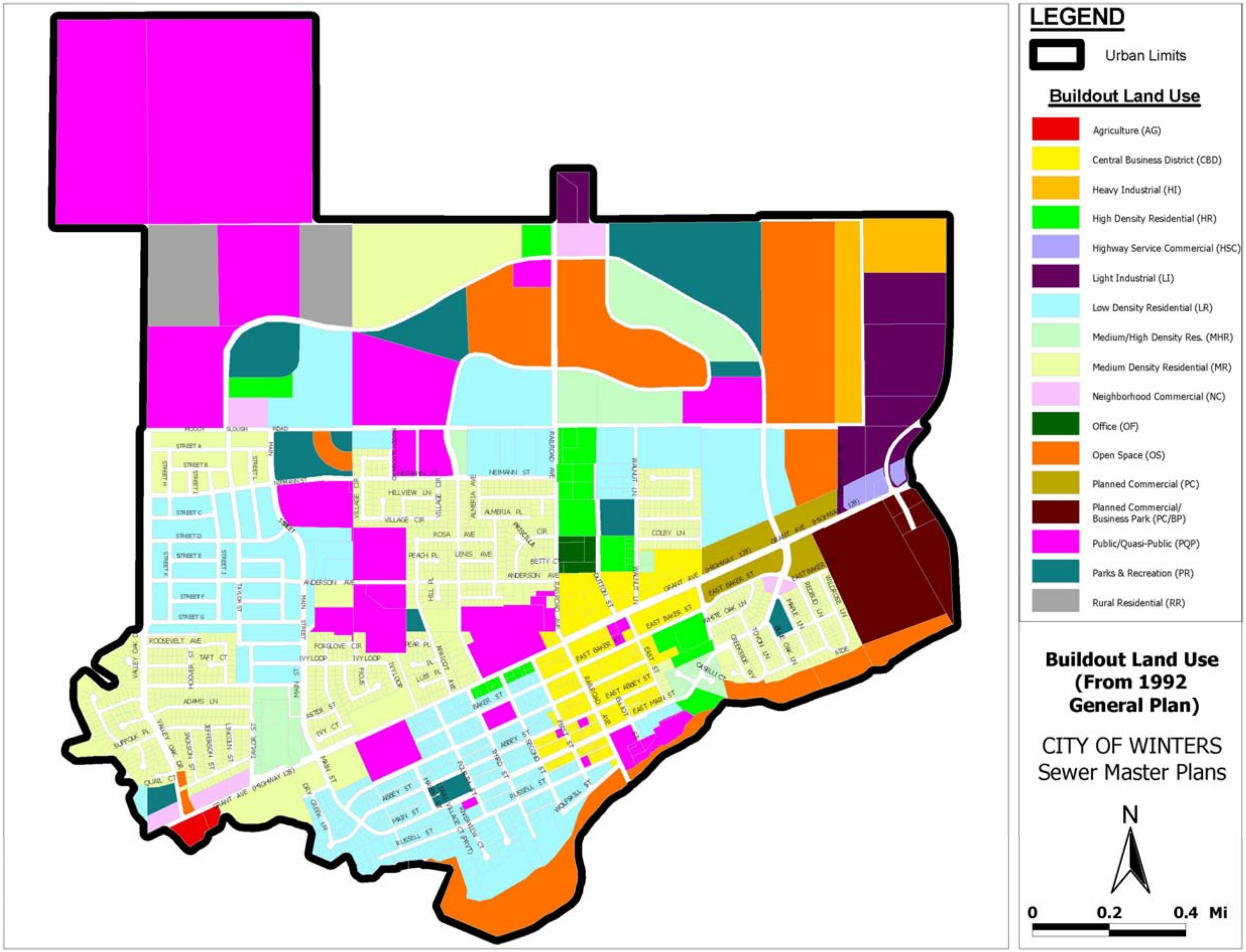


Table 2-1 provides the list of land use and zoning categories and associated density. The densities were used to estimate the number of persons or constructed area per parcel since this information is not an attribute of the parcel database. **Table 2-2** summarizes the acreage for each land use category, calculated based on parcel size information from the developed land use database.

For the future (i.e. buildout) scenario, the consultant team and City staff agreed that the most conservative scenario leading to the highest base wastewater flow generation should be considered for the purpose of this Master Plan. Key elements relevant to future land use are summarized below.

- **Planning Scenarios** – Two scenarios were evaluated as part of this Master Plan: a long-term/buildout land use scenario and a near-term evaluation of the Winters Highland and Callahan Developments.
- **Vacant Land Development Projects –** The majority of land within the urban service boundary of the City is currently undeveloped. Undeveloped lands are located to the north, east, and west areas of the City with future residential use being the largest usage category.
- **Redevelopment Projects** – Areas within Winters are in redevelopment zones. Based on discussion with City staff, the sewage generation factors that are currently being used for the redevelopment areas will also be applicable after redevelopment and therefore, will not impact this Master Plan.

Table 2-1: Land Use Categories and Associated Densities

LAND USE CATEGORIES	CODE	ZONING DESIGNATION	CODE	EXISTING & BUILDOUT DENSITIES	
				Residential Density [a] (DU/net acre)	Population Density [c] (Person/DU)
Residential					
Rural	RR	Rural	RR	0.5 - 1.0	3.5
Low Density	LR	Single Family (7,000 SF Ave. Min.)	R-1	1.1 - 7.3	3.5
Medium Density	MR	Single Family (6,000 SF Ave. Min.)	R-2	5.4 - 8.8	3.0 / 3.5 [d]
Medium/High Density	MHR	Multi-Family	R-3	6.1 - 10.0 [b]	3.0
High Density	HR	High Density Multi-Family	R-4	10.1 - 20.0 [b]	3.0
Commercial				N/A	N/A
Neighborhood	NC	Neighborhood	C-1		
Central Business District	CBD	Central Business District	C-2		
Highway Service	HSC	Highway Service	C-2		
Planned	PC	Planned	P-C		
Planned/Business Park	PC/BP	Planned/Business Park	PC/BP		
Industrial					
Light	LI	Light	M-1		
Heavy	HI	Heavy	M-2		
Other					
Agriculture	AG	General Agriculture	A-1		
Office	OF	Office	O-F		
Public/Quasi-Public	PQP	Public/Quasi-Public	PQP		
Parks & Recreation	PR	Parks & Recreation	PR		
Open Space	OS	Open Space	OS		

a. Source: City of Winters General Plan, May 1992, and General Plan Land Use Diagram Amendment Map, June 2003; Per conversation with the City, the Residential Density use for future residential developments on vacant parcels for the Sewer Collection System Master Plan shall be the densest allowed in the General Plan.

b. The Residential Density used for MHR and HR parcels under existing conditions is 6.1 and 10.1 DU/net acre, respectively.

c. Based on Section 7-2 of Winters Design Standards.

d. The Population Density used for MR parcels under existing conditions is 3.0 person/DU

e. Per conversation with the City, a floor-area-ratio (FAR) of 1.0 shall be applied for all non-residential parcels in calculating the proposed ADWF factor for the purpose of this master plan.

Table 2-2: Existing (as of September 2002) and Buildout Land Use Acreage by Category

LAND USE CATEGORIES	CODE	EXISTING LAND USE		BUILDOUT LAND USE	
		TOTAL NET ACREAGE [a]	% OF TOTAL	TOTAL NET ACREAGE [a]	% OF TOTAL
Residential					
Rural	RR	0	0.0	47	2.6
Low Density	LR	89	5.0	299	16.8
Medium Density	MR	196	11.0	314	17.6
Medium/High Density	MHR	16	0.9	69	3.9
High Density	HR	15	0.8	41	2.3
Sub-Total		***316***	***17.7%***	***770***	***43.2%***
Commercial					
Neighborhood	NC	4	0.2	22	1.2
Central Business District	CBD	46	2.6	63	3.5
Highway Service	HSC	1	0.1	6	0.3
Planned	PC	0	0.0	24	1.4
Planned/Business Park	PC/BP	0	0.0	54	3.0
Sub-Total		***51***	***2.9%***	***169***	***9.4%***
Industrial					
Light	LI	0	0.0	65	3.6
Heavy	HI	0	0.0	37	2.1
Sub-Total		***0***	***0.0%***	***102***	***5.7%***
Other					
Agriculture	AG	0	0.0	4	0.2
Office	OF	4	0.2	5	0.3
Public/Quasi-Public	PQP	280	15.7	399	22.4
Parks & Recreation	PR	14	0.8	145	8.1
Open Space	OS	49	2.7	188	10.6
Vacant	VC	1068	60.0	0	0.0
Sub-Total		***1,415***	***79.3%***	***741***	***41.6%***
	TOTAL	**1,782**	**100%**	**1,782**	**100%**

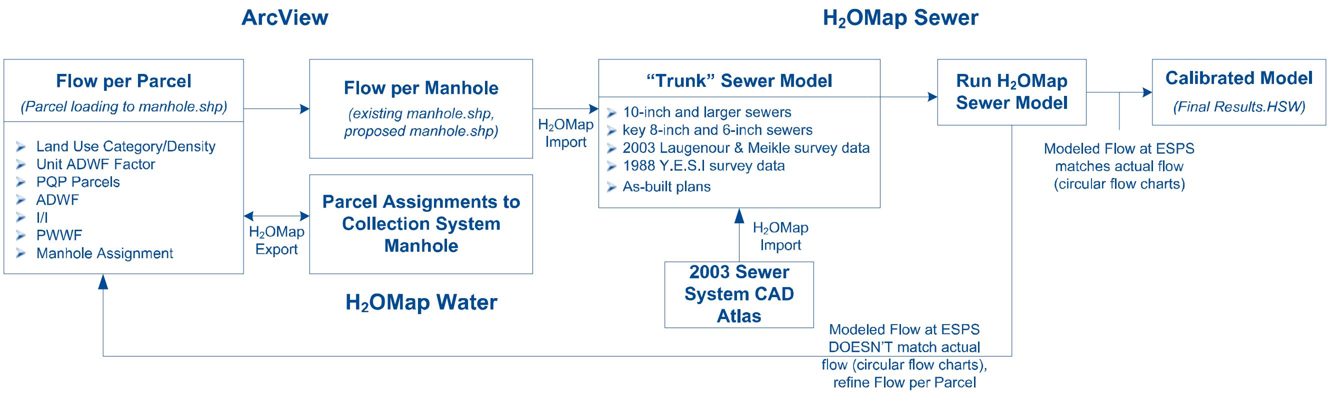
[a.] Estimated acreage based on land use GIS database (Appendix B). Net acreage excluded streets and roadways. Winters' urban limit line contains approximately 1980 gross acres. For this master plan, the existing net acreage (1,782 acres) is approximately 90 percent of the gross acreage. For a conservative analysis, it is assumed that the net acreage will not decrease for the buildout scenario even though more streets will be built within existing vacant parcels.

CHAPTER 3 HYDRAULIC MODEL DEVELOPMENT

Chapter Synopsis: This chapter discusses the hydraulic model development process used to ensure that the computer model represents 2002 conditions as accurately as possible. It also includes discussions on the wastewater flows input into H_2OMap Sewer for calibration and for performing sanitary sewer system analysis under existing and future conditions (see also Chapter 5).

*The methodology used to develop the City's H_2OMap Sewer model is shown in **Figure 3-1**.*

Figure 3-1: Methodology for Developing the City's H_2OMap Sewer Model



3.1 Develop Physical Model

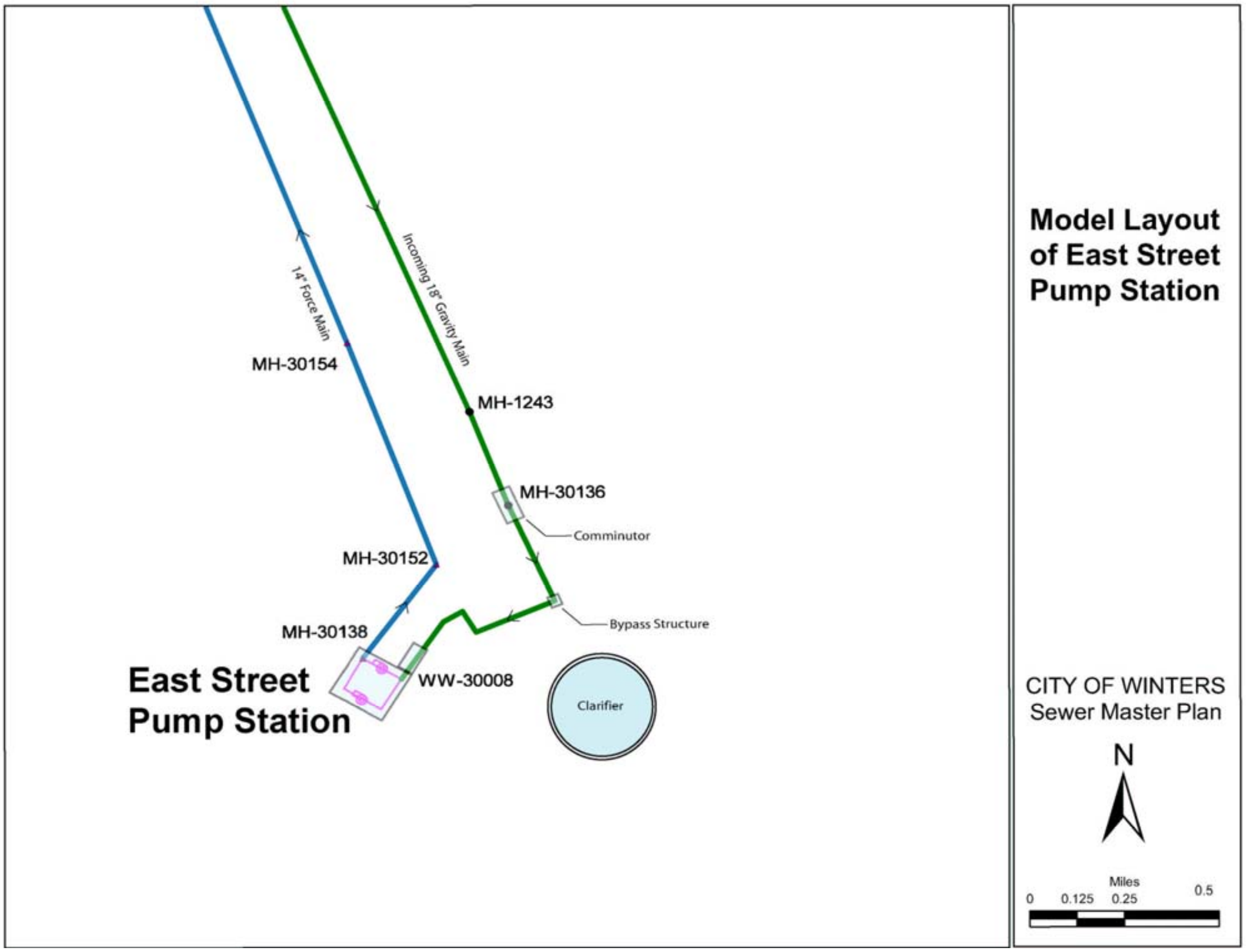
A steady state/static hydraulic model of the trunk sewer collection system was developed as part of this Sewer System Master Plan using H_2OMap Sewer Pro, Version 5.0. The model of the trunk collection system included all sewers 10-inches and larger, key 8-inch sewers, and, in the downtown area, key 6-inch sewers. All existing manholes and sewers were named using a two letter identifier, MH for manhole and SP for sewer pipe, followed by a 4 digit number. Manholes and sewers south of Grant Avenue were assigned a 4 digit number in the 1,000 series while those located north of Grant Avenue were assigned a 4 digit number in the 2,000 series[3]. Proposed manhole and sewer improvements were also named using a two letter identifier, but followed by a 5 digit number in the 30,000 series. Hence, for example, an identifier of MH-1055 denotes an existing manhole located to the south of Grant Avenue while an identifier of SP-30103 denotes a new sewer. A 42 inch by 60 inch map showing the identification (ID) number of all manholes and sewers is included as a *.pdf file in the CD in Appendix B.

Flows from the Carter Ranch Pump Station were assigned to the 10-inch sewer main in Grant Avenue to flow to the East Street PS for the existing scenario and assigned to the 8-inch Main Street sewer to flow north to Future Pump Station A for the buildout scenario. The East Street Pump Station was modeled based on the as-built drawings provided by the City. **Figure 3-2** presents a schematic of the East Street Pump Station as it appears in H_2OMap Sewer. The Walnut Lane PS was not modeled since it is a minor "neighborhood" pump station. Flows from the El Rio Villa PS were assigned to manhole MH-1191 located at East Street and Grant Avenue to

[3] Certain adjustments to the model since the draft completion of the 2005 Sewer Master Plan have resulted in minor changes to pipe and manhole numbering schemes for certain portions of the collection system. Refer to Appendix B for a complete list of pipe and manhole numbers.

flow to the East Street PS for the existing scenario and assigned to future MH-30082 on future Main Street Loop to flow to Future PS C for the buildout scenario.

Figure 3-2: Model Layout of East Street Pump Station



The following information was combined to create the physical (i.e. pipe, manhole, connectivity, inverts, etc.) H_2OMap Sewer model:

- **2003 Sewer System CAD Atlas** – This file was created as part of this project from the City's existing sewer atlas and updated with as-built maps. The CAD file was imported into H_2OMap Sewer and used as a base for developing the existing trunk model with manhole and pipe diameter information.

- **2003 Laugenour & Meikle Survey Data** – Rim and invert elevations for 16 manholes, ground surface elevations for 14 locations, flowline elevations for 2 crossing locations along the Willow Canal, and flowline elevations for 3 crossing locations along Moody Slough were surveyed as part of the 2006 Sewer Collection System Master Plan Project to establish a base elevation grid for modeling the collection system. The survey datum and coordinate system is the same datum used by the Winters Highland and Callahan Development drawings (i.e. NAD 83 – CA Zone 2 and NGVD 29). The survey information is attached in Appendix B.

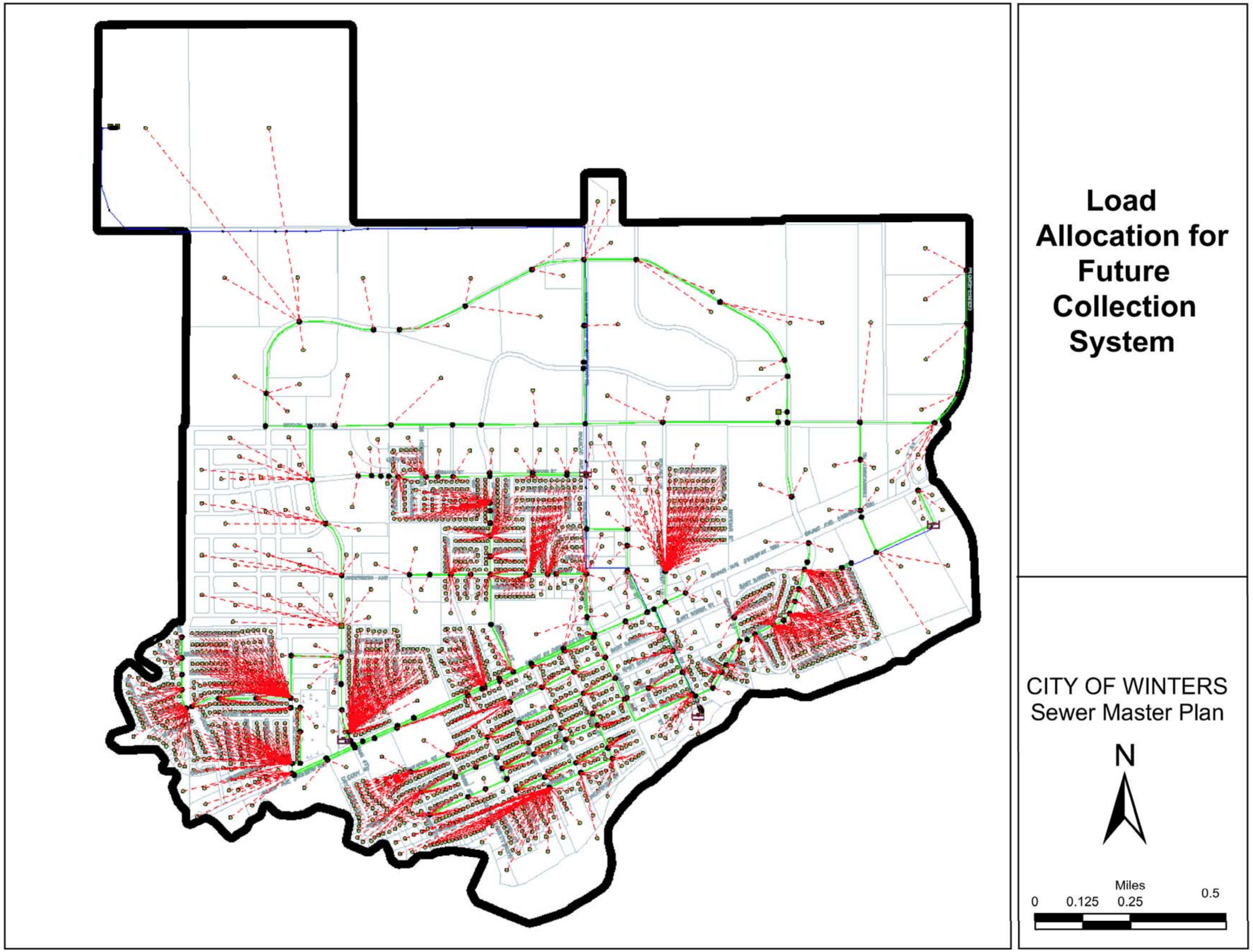
- **1988 Yolo Engineers & Surveyors, Inc. (Y.E.S.I.) Survey Data** – Prior to being entered into the model, Y.E.S.I.'s surveyed invert information from a 1988 sewer collection system mapping project were adjusted to the datum used by Laugenour & Meikle in 2003 for the project.

- **As-Built Plans** – Slopes, invert elevations, and pipe sizes for sewers constructed after 1988 were gathered from various as-built plans and adjusted to the datum used by Laugenour & Meikle in 2003 for this project.

The resulting GIS shapefile (Parcel loading to manhole.shp) was then imported into the H_2OMap Sewer model to assign flows from each parcel to their associated manholes in the collection system. Load allocations for the recommended future collection system are shown in **Figure 3-3**. The manhole assignments became an attribute of the GIS shapefile. The GIS shapefile was then summarized by flows per manhole and a new shapefile was created (existing modeled manhole.shp) and imported into the H_2OMap Sewer model for system analysis (Final Results.HSW). This methodology was illustrated previously in Figure 3-1. All GIS and H_2OMap Sewer files, a table listing all sewer loads by parcel, and a 42 inch by 60 inch map showing the identification (ID) number of all parcels are included in Appendix B

After the computer model was developed, estimated existing wastewater flows were input in the H_2OMap Sewer model and refined until the model was calibrated (i.e. modeled flows at the East Street PS matched with average recorded flows from the station's circular flow chart). Wastewater flows were subsequently developed using the methods described in the following sections.

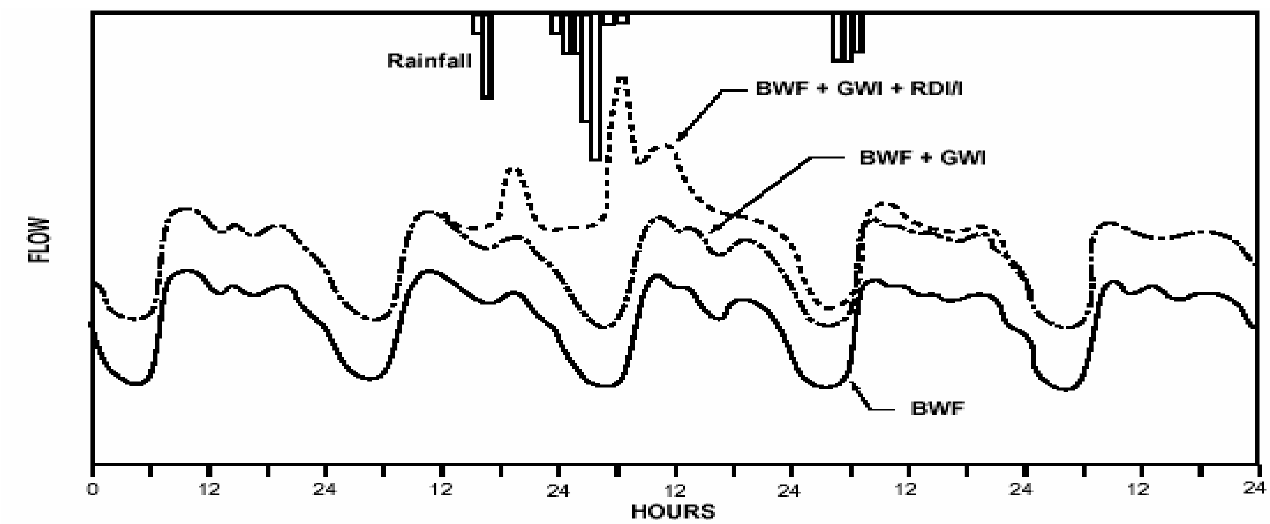
Figure 3-3: Load Allocation for Recommended Future Collection System



3.2 Wastewater Flow Components

The basic components of wastewater flows are base wastewater flow (BWF) and infiltration/inflow (I/I). BWF is generally defined as the combined sanitary and processed flow contributed by residential, commercial, industrial, and institutional users of the sewer system. BWF rates vary based on the land use category, the hour of the day, and the day of the week. I/I is extraneous (i.e. non BWF) water that enters the sewer system. I/I includes dry and wet weather groundwater infiltration (GWI) and rainfall-dependent I/I (RDI/I). These components are described below and shown in **Figure 3-4**.

Figure 3-4: Wastewater Flow Components



As the term GWI implies, GWI is groundwater that infiltrates the sewer collection system via cracks and defects in pipes, pipe joints, and sewer structures such as manholes. As such, the magnitude of GWI depends upon the age and physical condition of the sewer system as well as the relative elevation of the groundwater table with respect to the sewer system. GWI tends to decrease during the dry summer and fall months and increases during the wet weather season. GWI rates can be considered constant over short time durations, since changes in the groundwater table occur relatively slowly (over a matter of weeks or months rather than hours).

In theory, BWF should not include dry weather GWI (or base infiltration). However, it is almost impossible, and not practical to accurately separate dry weather GWI from BWF based on actual measured flows. Therefore, the combination of BWF plus base infiltration is typically considered as a single component, termed average dry weather flow (ADWF). The term GWI is then primarily used to refer to the wet weather component of GWI, or the increase in GWI between the dry and wet weather season.

RDI/I is storm water that enters the sewer system in direct response to rainfall. RDI/I may enter the system directly by such means as cross-connections between the storm drain and sanitary sewer systems or through area drains and downspouts illegally connected to the sanitary sewer system. RDI/I may also enter the sewer system indirectly through sewer defects, particularly in shallow pipes such as private building laterals. RDI/I flows are directly related to the intensity and duration of rainfall, and generally rise quickly and recede very rapidly after the end of the storm. In addition to being dependent on rainfall, RDI/I is sensitive to soil moisture and tends to be most significant late in the wet season or after extended periods of rainfall when the soil is highly saturated.

3.3 Wastewater Design Flow Criteria

Since actual flow monitoring data was not available, there was no distinction made between weekday and weekend flows; and calibrated existing wastewater flows were used as "design" wastewater flows to perform the sanitary sewer system analysis. Furthermore, it was assumed that sewage generation factors and I/I rates will be the same for the existing and buildout land use scenarios, which assumes that future sewage generation characteristics will not be affected by factors such as water conservation, increase in sewer system age, etc. The criteria for simulating hourly, weekday, and seasonal flow variations are typically defined by the type of hydraulic model used. The hydraulic model selection and design flow criteria are described in the following sections.

3.3.1 Hydraulic Model

There are two types of hydraulic models used to simulate a sewer collection system: 1) steady state/static simulation and 2) extended period/dynamic simulation. Simulations from a steady state model represent a snapshot of the system performance at a given point in time under specific sewage generation conditions (i.e. ADWF, PDWF, PWWF, etc.). The extended period model is a continuous simulation of the change in system flow rate and is typically used to analyze the operational performance of the system over a 24-hour period. Dynamic modeling requires more extensive data input, including various 24-hour sewage generation patterns (also known as diurnal curves or wastewater profiles) for various land use categories within the sewer collection system.

Extended period simulations are typically used to evaluate operational studies, whereas steady-state models are used for sizing of sewers and pump stations. Hence, for the purpose of this master plan, a steady-state hydraulic model will be used in the system analyses to size sewers and pump stations.

3.3.2 Design Flow (PWWF)

Sewer system facilities must be sized to convey the peak flows in the system. Typically, the peak flow occurs during a wet weather event, and is therefore termed the peak wet weather flow (PWWF). Since the design storm peak can occur at any time of the day, it was assumed for a steady-state model and conservative master plan criteria that the peak I/I flow would coincide with the peak dry weather flow (PDWF). The design flow or PWWF for any segment of the sewer system is therefore calculated using the following formula:

Design Flow = PWWF
PWWF = [ADWF * PF] + [I/I]
= PDWF + I/I

The development of each of these flow components is discussed in detail in the following sections.

3.3.2.1 Average Dry Weather Flow (ADWF)

For the purpose of this master plan, BWF was combined with dry weather GWI to form a single component, termed average dry weather flow (ADWF). A specific unit ADWF factor (in gpd/acre or gpd/person) was combined with existing and buildout land use information (acreage or person) to calculate the ADWF input for each parcel in the previously developed land use database. Maps of the identified existing and buildout land uses are located in Chapter 2. The weekday flow variation shall be reflected in the peaking factor use for steady-state modeling analyses. A summary of the 1992 and 2002 ADWF factors, with associated land use categories are presented in **Table 3-1**.

Residential

Existing residential flows shall be generated based on a population method. Based on Section 7-2 of the City's June 2003 Design Standards, a per capita flow factor of 90 gallons per day (gpcd) will be used along with the population density listed in the General Plan to generate flows for each developed residential parcel. Hence, existing residential ADWF flows is generated for each developed parcel using the following formula:

ADWF (gallons per day - gpd) = [Population Density]*[90 gpcd]

For vacant and existing developed high density residential area where more than one resident/house could be and are developed on each parcel, the flow will be generated based on an areal method using the unit areal flowrates (gpd/net acre). The proposed and 1992 Sewer System Master Plan areal ADWF factors are listed in Table 3-1 for comparison. Proposed residential areal ADWF factors were developed using the following formula:

ADWF Factor (gpd/net acre) = [Residential Density]*[Population Density]*[90 gpcd]

For existing scenarios, the residential density used for generating flows from existing developed high density residential parcels is the minimum density listed in the General Plan (i.e. 6.1 and 10.1 DU/acre for MHR and HR categories, respectively). To be conservative, it is assumed that vacant residential parcels will be developed according to the maximum residential density allowed for each category (i.e. 7.3 DU/net acre for LR, 20.0 DU/net acre for HR, 10.0 DU/net acre for MHR, etc.)

Table 3-1: 2002 and 1992 ADWF Factor and Flow Rate by Land Use Category

LAND USE CATEGORIES	CODE	2002 ADWF FACTOR [a] (gpd/net acre)	1992 ADWF FACTOR [b] (gpd/acre)
Residential			
Rural	RR	**315** [c]	500
Low Density	LR	**2,300** [c]	1,500
Medium Density	MR	**2,772** [c]	2,000
Medium/High Density	MHR	**1,647 / 2,700** [c, d]	2,500
High Density	HR	**2,747 / 5,400** [c, d]	3,500
Commercial			
Neighborhood	NC	**2,500**	2,500
Central Business District	CBD	**3,500**	3,500
Highway Service	HSC	**2,500**	2,500
Planned	PC	**2,500**	2,000
Planned/Business Park	PC/BP	**2,500**	2,500
Industrial			
Light	LI	**2,000**	2,000
Heavy	HI	**5,000**	3,000
Other			
Agriculture	AG	**0** [e]	n/a
Office	OF	**2500**	2500
Public/Quasi-Public	PQP	**Varies** [f]	Varies
Parks & Recreation	PR	**200**	200
Open Space	OS	**0**	n/a

a. A floor area ratio (FAR) of 1.0 were applied for all non-residential parcels in calculating the ADWF factor.
b. Source: City of Winters Sewer System Master Plan, CH2M Hill, May 1992.
c. For each existing occupied/non-vacant residential parcel ADWF Factor = [Population Density]*[90 gpcd]. For existing occupied MHR and HR parcels ADWF Factor = [Residential Density]*[Population Density]*[90 gpcd] where from Table 2-1, the Residential Density used for MHR and HR parcels under existing condition is 6.1 and 10.1 DU/net acre, respectively. For vacant residential parcels, ADWF Factor for the buildout scenario = [maximum Residential Density]*[Population Density]*[90 gpcd]. Residential and Population Density are presented in Table 2-1.
d. From note c above and Table 2-1, ADWF Factor for existing occupied MHR and HR parcels is 1,647 gpd/acre and 2,747 gpd/acre, respectively. ADWF Factor for the buildout scenario for MHR and HR parcels is 2,700 gpd/acre and 5,400 gpd/acre, respectively.
e. Assumed Agriculture parcels are using septic tanks and are not connected to the sewer collection system.
f. ADWF for PQP parcels were evaluated on a case by case basis and presented in Table 3-2.

The population density used to generate existing flow for the Medium Density (MR) Residential Land Use category was reduced from 3.5 person/DU, as listed in the General Plan, to 3.0 person/DU to arrive at a more realistic total existing daily flow value for the City. The other option for reducing flow was to reduce the per capita design flow rate of 90 gpcd. Since flow data was not available to determine the actual per capita flow, it was decided to keep the conservative design rate of 90 gpcd for master planning purposes and reduce the population density for the MR category (the largest residential land use category) instead. With a population density of 3.0 persons/DU for MR category, the total average dry weather daily flow for the City is 0.83 mgd as oppose to 0.88 mgd.

Commercial, Industrial, and Others

Non-residential flows shall also be generated based on an areal method for different land use categories in the City's Design Standards. Commercial, industrial, and other ADWF factors are defined in the City's Design

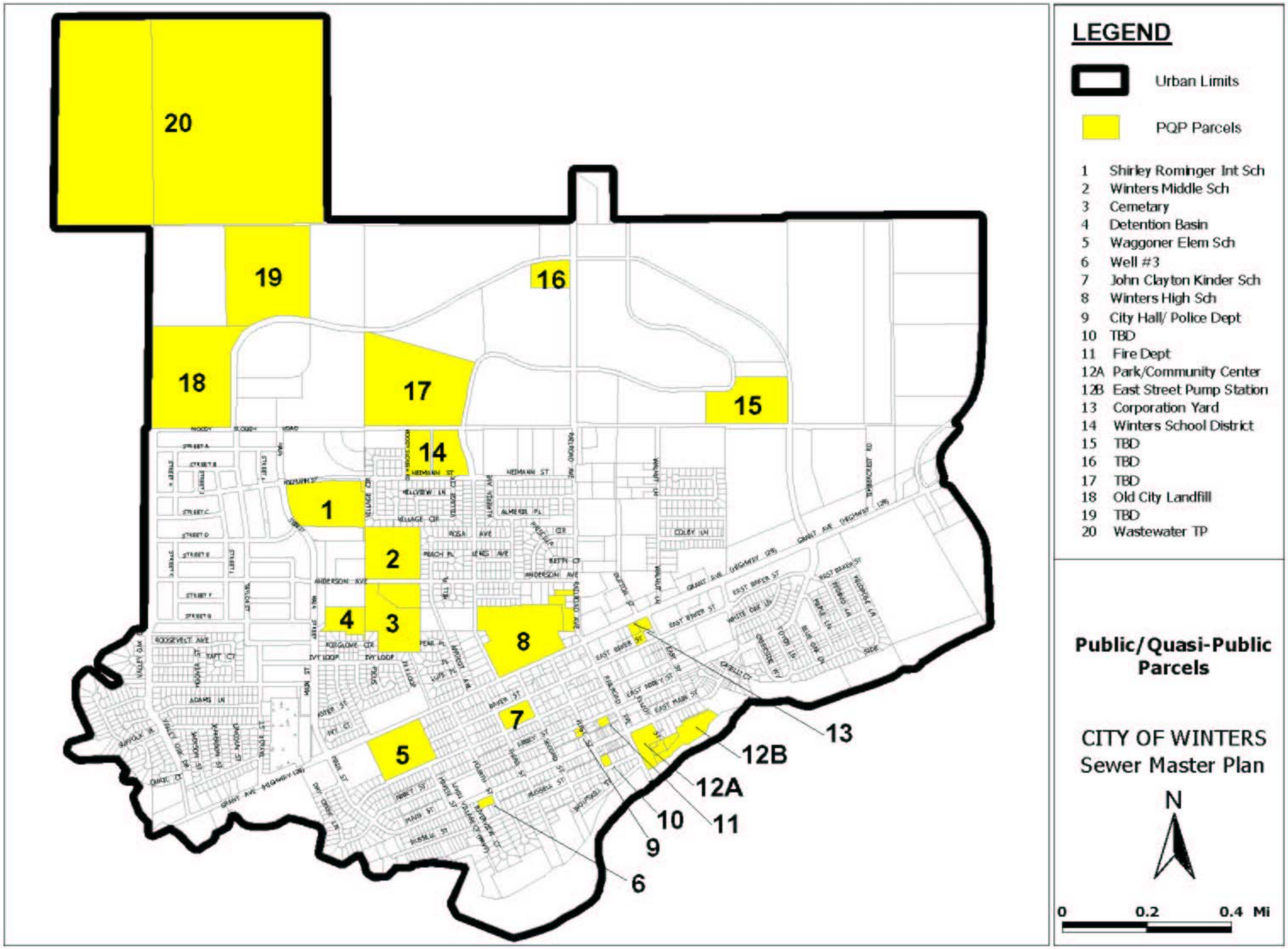
Standards. These proposed values are also listed in Table 3-1 along with values used in the 1992 Sewer Master Plan. For the most part, except for the Planned Commercial and Heavy Industrial categories, the proposed ADWF factor and those used in the 1992 Sewer System Master Plan are identical to each other.

According to the General Plan, the standards of building intensity for non-residential uses are stated as maximum floor-area ratios (FARs) based on net acreage. A FAR is a ratio of the gross building area zoned for a particular usage category to the net area of the parcel. Per conversation with the City, a FAR of 1.0 shall be applied for all non-residential parcels in calculating the proposed ADWF factor for the purpose of this master plan.

Public/Quasi-Public

Various locations within the City are zoned public/quasi-public (PQP) and are shown in **Figure 3-5**. PQP areas include a variety of areas including schools, parks, City Hall, and detention basins. For this master plan, the applicable sewage generation calculation will be determined on a case by case basis for each PQP area with schools being treated as point sources. **Table 3-2** is a listing of the sewage generation flowrates for each PQP location.

Figure 3-5: Public/Quasi Public Parcels



Note: Not all well locations are shown due to the fact that some wells are located on non P/QP parcels

Table 3-2: ADWF for PQP Parcels

PQP PARCEL	DESCRIPTION	EXISTING ADWF [a] (gpd)	BUILDOUT ADWF [a] (gpd)	EQUIVALENT LAND USE [b]	COMMENT
1	Shirley Rominger Intermediate School	18,000	35,000 [c]	N/A	Existing = 360 students Buildout = 700 students
2	Winters Middle School	23,000	30,000 [c]	N/A	Existing = 460 students Buildout = 575 students
3	Cemetery	7,200	7,200	N/A	Small office facility.
4	Detention Basin	0	0	N/A	
5	Waggoner Elementary School	35,000	35,000 [d]	N/A	Existing = 700 students Buildout = 700 students Assumed connection at Grant Ave.
6	Well [g]	0	0	N/A	
7	John Clayton Kinder School	10,000	25,000 [d]	N/A	Existing = 200 students (10,000 gpd) Buildout = 200 students (10,000 gpd)
8	Winters High School	37,620	45,000 [e]	N/A	Existing = 627 students Buildout = 700 students Assumed connection at Railroad Ave (90% of flow - gym) Grant Ave. (10% of flow - admin.)
9	City Hall / Police Dept	3,500 gpd/net acre	3,500 gpd/net acre	CBD	
10	Yolo County Library	3,500 gpd/net acre	3,500 gpd/net acre	CBD	
11	Fire Department	3,500 gpd/net acre	3,500 gpd/net acre	CBD	
12A	Park/Community Center	3,500 gpd/net acre	3,500 gpd/net acre	CBD	Sewage generation is highly variable and is assumed to be equivalent to CBD parcels
12B	East Street Pump Station / Well [g]	0	0	N/A	
13	Corporation Yard / Well [g]	3,500 gpd/net acre	3,500 gpd/net acre	CBD	Sewage generation is highly variable and is assumed to be equivalent to CBD parcels
14	Winters School District	0	6,000 [f]	N/A	Existing = 0 students Buildout = 100 students

PQP PARCEL	DESCRIPTION	EXISTING ADWF [a] (gpd)	BUILDOUT ADWF [a] (gpd)	EQUIVALENT LAND USE [b]	COMMENT
15	Future Elementary School	0	35,000 [d]	N/A	Existing = 0 students Buildout = 700 students
16	Future Fire Station	0	3,500 gpd/net acre	CBD	
17	Future High School	0	60,000 [e]	N/A	Existing = 0 students (0 gpd) Buildout = students (60,000 gpd)
18	Landfill (closed) and Future Park	0	900	PR	Parcel is approximately 30 acres. 75% of parcel will be a park, 25% of the parcel will not be developed.
19	Future City Facility	0	30,000	NC OF	The future use of this 30 acre site is unknown. Assume future sewer generation equivalent to NC and OF parcels.
20	Wastewater Treatment Plant	0	0	N/A	

a. Rounded to the nearest 1,000.
b. For modeling purposes. The equivalent Land Use categories and their codes are shown in Table 1.
c. From the City's Design Standards, ADWF = 50 gpd/student, but not less than 30,000 gpd at buildout.
d. From the City's Design Standards, ADWF = 50 gpd/student, but not less than 25,000 gpd at buildout.
e. From the City's Design Standards, ADWF = 60 gpd/student, but not less than 45,000 gpd at buildout.
f. From the City's Design Standards, ADWF = 60 gpd/student.
g. Not all wells are shown due to the fact that some wells are located on non-PQP parcels.

Large Dischargers

Flows from large dischargers, such as major industries and large institutions, are treated as point sources in developing system wastewater flows since they cannot be accurately estimated using the typical areal unit flowrates described above. For this master plan, the Mariani Nut and Fruit Company and El Rio Villa have been identified as the only large dischargers for the City.

The Mariani facility is located to the east of Railroad Avenue from Anderson Avenue to Abbey Street. Based on examination of aerial photography, it appears that the main processing area is located north of Grant Avenue between Dutton Street and Walnut Lane. This three acre parcel is assumed to generate 100 gpm (0.144 mgd) of ADWF. The dry weather peaking factor of 3 will also be applied to the Mariani facility (PDWF = 300 gpm or 0.432 mgd). This ADWF correspond to an areal flowrate of 48,000 gpd/acre. This flowrate assumption can be modified as necessary as the City collects additional flow data from the Mariani facility.

El Rio Villa is a small subdivision located approximately 0.7 miles east and outside of the City's urban limit boundary. The City has a contract with Yolo County to convey and treat the sewage from El Rio Villa and there are no plans to increase the size of this small subdivision. Wastewater from El Rio Villa is collected and pumped to the City's sewer collection system via the El Rio Villa Pump Station (ERVPS).

The ERVPS is a two-stage pump station consisting of two pairs of pumps. Each pair of pumps can pump 155 gpm. It is assumed that one of the pairs of pumps provides stand-by capacity. Flow data from the ERVPS indicated that on an average dry day, the pumps are activated approximately 50 times a day for a minute or two each time. Therefore, even though the pump station only pumps 12,000 gallons on an average dry weather day (equivalent to 8.3 gpm), the sewer system must be capable of conveying a flowrate of 155 gpm.

Further downstream in the sewer system, it may be possible to reduce the impact of this short duration peak flow as the peak is attenuated. For example, the impact of the flow from the ERVPS on the East Street Pump Station is closer to 10 gpm than 155 gpm. This reduction of impact will be evaluated on a case-by-case basis during modeling.

Estimated ADWF Flows

Table 3-3 presents the existing and buildout ADWF generated for the City based on the methodology discussed above. The existing and buildout ADWF generated is approximately 0.83 mgd and 2.81 mgd, respectively[4]. The ADWF value of 0.83 mgd for existing condition is a reasonable assumption and validates the proposed methodology since the average daily flow at the treatment plant is 0.83 mgd[5]. The ADWF projection of 2.81 mgd for the buildout land use scenario is a conservative value assuming that the maximum density allowed by the General Plan would be implemented and is a reasonable assumption for collection system master planning purposes.

[4] Does not include flows from El Rio Villa.
[5] Larry Walker Associates, *City of Winters Sewer Master Plan Update – Wastewater Treatment Facilities*, December 2000.

Table 3-3: Land Use Categories and Existing and Buildout ADWF Flows

LAND USE CATEGORIES	CODE	EXISTING LAND USE		BUILDOUT LAND USE	
		TOTAL NET ACREAGE	TOTAL ADWF (gpd)	TOTAL NET ACREAGE [a]	TOTAL ADWF (gpd)
Residential					
Rural	RR	0	0	47	14,800
Low Density	LR	89	138,000	299	694,000
Medium Density	MR	196	284,600	314	626,000
Medium/High Density	MHR	16	27,000	69	172,000
High Density	HR	15	41,400	41	183,000
Sub-Total		***316***	***491,000***	***770***	***1,689,800***
Commercial					
Neighborhood	NC	4	9,800	22	55,100
Central Business District	CBD	46	162,100	63	220,000
Highway Service	HSC	1	2,200	6	13,800
Planned	PC	0	0	24	58,900
Planned/Business Park	PC/BP	0	0	54	136,100
Sub-Total		***51***	***174,100***	***169***	***483,900***
Industrial					
Light	LI	0	0	65	129,600
Heavy	HI	0	0	37	186,300
Sub-Total		***0***	***0***	***102***	***315,900***
Other					
Agriculture	AG	0	0	4	0
Office	OF	4	11,200	5	13,200
Public/Quasi-Public	PQP	280	150,300	399	374,000
Parks & Recreation	PR	14	1,900	145	29,000
Open Space	OS	49	0	188	0
Vacant	VC	1068	0	n/a	n/a
Sub-Total		***1,415***	***163,400***	***741***	***416,200***
	TOTAL	**1,782**	**0.83 mgd**	**1,782**	**2.81 mgd**

3.3.2.2 Peak Dry Weather Flow (PDWF)

Base wastewater flows vary throughout the day, with peak flow periods typically occurring in the morning and early evening hours. The ratio between these daily peak flowrates and the average flowrates is generally expressed as a peaking factor:

Peak Dry Weather Flow = [Average Dry Weather Flow] x [Peaking Factor]

or PDWF = ADWF x PF

Peaking factors are often developed based on dry weather flow monitoring data for steady state hydraulic simulation. The 1992 Sewer System Master Plan stated that peaking factors in the system varied from 2.3 to 4.0, but it is unclear which peaking factor(s) was used. A peaking factor of 3 will be used in this master plan, since the City does not have any current flow monitoring data. The peaking factor will be applied to all land uses except for Parks & Recreation and El Rio Villa parcels. These parcels will use a peaking factor of 1 since park parcels generally have a very flat diurnal curve and the El Rio Villa PS conveys flows to the collection system at an "instantaneous" flowrate that does not vary between dry weather and wet weather.

In large collection systems, the peak flows are attenuated as the flows move downstream. This is partly due to the difference in travel times of the various sewersheds (i.e. the peaks do not arrive at the same time). However, for the purpose of steady state modeling and since the size of the City's sewer collection system is relatively small, it is both reasonable and conservative to assume that all the peaks will arrive at the same time and to size conveyance and pumping facilities accordingly.

3.3.2.3 Infiltration/Inflow (I/I)

The 1992 Sewer System Master Plan did not reference any I/I rate. The I/I is assumed to be at a constant rate of 600 gpd/net acre. This is consistent with the City of Woodland's Design Standards and based on conversation with City staff, it will be included in the City of Winters' Improvement Standards.

3.4 Wastewater Flow Projections

The PWWF was created as an additional attribute in the parcel loading GIS shapefile (Parcel loading to manhole.shp) and calculated by applying the peaking factor to the ADWF and adding the I/I flow. A table listing sewer loads by parcel is presented in Appendix B.

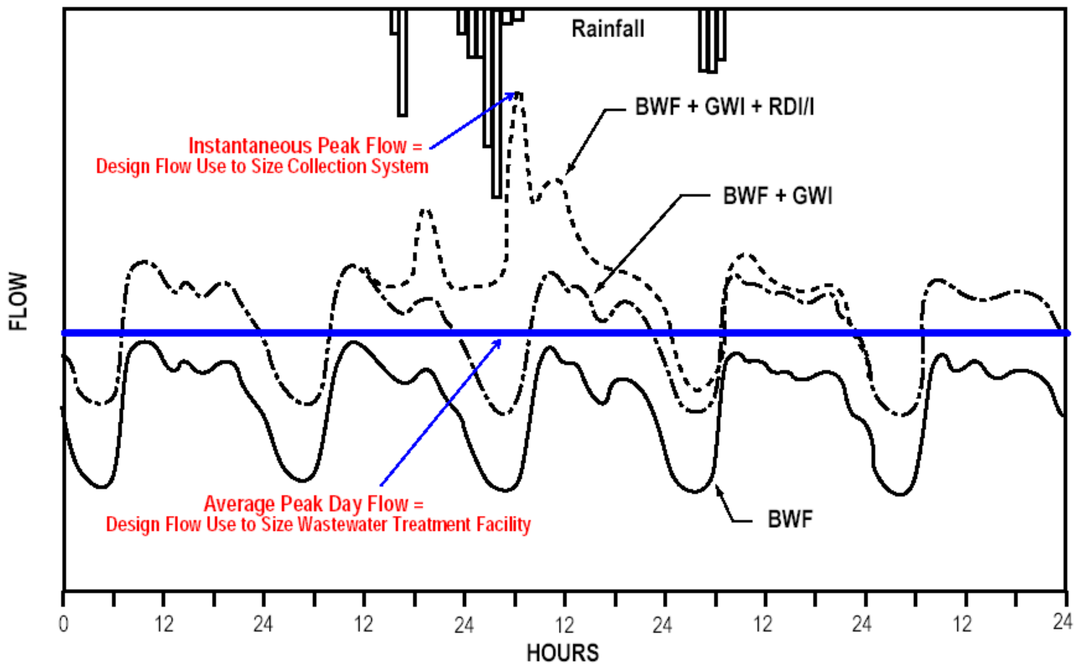
Table 3-4 presents the estimated ADWF and PWWF for the planning area for existing and future conditions.

Table 3-4: Wastewater Flow Projections

ESTIMATED FLOW (MGD)	2002	BUILDOUT
Average Dry Weather Flow (ADWF)	0.84	2.81
Peak Wet Weather Flow (PWWF)	2.96	9.67

The ADWF and PWWF of 2.96 MGD and 9.67 MGD, respectively, for the buildout scenario in this master plan are higher than the average and peak design flow used in the City's Wastewater Treatment Facilities Master Plan (Larry Walker & Associates, 2001) of 1.8 MGD and 6.0 MGD, respectively. It is normal for design flows generated by a collection system master plan to be higher then design flows generated by a wastewater treatment facility master plan for any given city since the design goals for these two master plans are different. A collection system is designed with adequate capacity to convey the peak instantaneous flow in order to avoid overflows and a treatment plant is designed to treat a flow with the peaks attenuated. Figure 3-6 shows a typical sewage flow pattern over a 24-hour period. As shown in **Figure 3-6**, the design flow for a collection system is the instantaneous peak wet weather flow while the design flow for a wastewater treatment facility is the average peak day flow.

Figure 3-6: Design Values Use to Size Collection System vs. WWTF Master Plan



<u>Footnotes:</u>

BWF = base wastewater flow; GWI = groundwater infiltration; RDI/I = rainfall dependent infiltration/inflow.

CHAPTER 4 SEWER COLLECTION DESIGN CRITERIA

Chapter Synopsis: Presents the design criteria recommended for use for the Sewer Collection System Master Plan for the City of Winters. These criteria will serve as the basis for evaluating the hydraulic adequacy of existing facilities and for establishing the alignment and size of future facilities, including gravity trunk sewers, pump stations, and force mains.

4.1 Introduction

This Chapter includes a brief discussion of each of the following items and recommendations for design criteria for the Winters Master Plan.

- Manning's *'n'* factor
- Minimum Pipe Size
- Maximum Allowable Flow Depth
- Minimum Velocity/Slope
- Maximum Velocity
- Maximum Collector Sewer Depth
- Minimum Pipe Depth
- Design Requirements at Increases in Pipe Size
- Headloss in Manholes
- Hydraulic Design Criteria for Force Mains
- Inverted Siphons

4.2 Summary of Recommended Master Plan Design Criteria

A summary of the recommended design criteria is presented in **Table 4-1**.

Table 4-1: Recommended Master Plan Design Criteria

CRITERIA	RECOMMENDED VALUE
Manning's *'n'*	0.013 for all materials
Minimum Gravity Sewer Pipe Size	8 inches
Maximum Allowable Flow Depth (d/D)	Under peak design flow conditions: ▪ d/D = 0.7 for 8- and 10-inch pipe and 12-inch pipe with service connections ▪ d/D = 1.0 for 12-inch (without service connections) and larger pipe.
Minimum Velocity/Slope	▪ Criteria 1: Minimum design slope selected to provide a minimum velocity of 2 fps for sewers between 8- and 18-inch and a minimum velocity of 3 fps for sewers 39-inch and larger. For sewers between 21- and 36-inch, the minimum slope allows the velocity to transition from 2 fps to 3 fps. Velocities calculated with Manning's '*n*' =0.013 and full pipe conditions. See Tables 4-5 and 4-6. ▪ Criteria 2: Minimum velocity of 2 fps at peak dry weather flow at buildout.
Maximum Velocity	10 fps

CRITERIA	RECOMMENDED VALUE
Maximum Collector Sewer Depth	▪ 8- and 10-inch pipe and 12-inch pipe with service connections have a maximum depth of 16 feet.
Minimum Pipe Depth	▪ Provide a minimum depth to pipe invert of 7 feet for all gravity sewers including the sewers at the periphery of the system. ▪ At least 4 feet of separation between the flow line of creeks and the crown of the sewer at creek crossings.
Increases in Pipe Size	▪ Match crowns when increasing in pipe size. ▪ Set branch sewer elevations 0.1 ft. above the main sewer elevation when the branch sewer is the same size as the main sewer.
Headloss in Manholes	Deflection manholes with deflections greater than 20 degrees are assigned a 0.1-foot drop. Deflections greater than 90 degrees are not allowed.
Force Mains	▪ Maximum velocity: 8 fps during PWWF at buildout. ▪ Minimum velocity: 3.5 fps with one pump running (force mains with 20% slope or less); additional analysis required (force mains with greater than 20% slope) ▪ A method to allow dewatering and internal inspection of force mains during summertime flow shall be provided. For short force mains that do not cross railroads, freeways, or rivers, bypass pumping using temporary above ground piping is acceptable. For long force mains, dual force mains shall be provided. Dual force mains would not be required at the initial stage unless low initial flows (and velocities) require dual pipelines to keep grit moving. ▪ Pipe friction will be calculated using the Hazen-Williams formula with a roughness coefficient C = 100 for all pipe sizes and materials.
Inverted Siphons	▪ Avoid inverted siphons whenever possible. ▪ Downflow and upflow legs of the siphon have a maximum slope of 15 percent. ▪ Upstream invert elevation will be calculated by adding 12 inches plus the pipe friction to the downstream invert elevation. ▪ Pipe friction will be calculated using the Hazen-Williams formula with a roughness coefficient C = 100. ▪ Minimum velocity of 3 fps at ADWF during early years of operation ▪ Minimum velocity of 4 fps at PDWF during early years of operation. ▪ Minimum pipe diameter of 8 inches and minimum of two barrels. ▪ The downstream manhole must be located in an easily accessed location and safely accessed (busy street locations are not allowed).

4.2.1 MANNING'S 'N' FACTOR

Manning's 'n' roughness coefficient is the friction factor utilized in the Manning's Equation for gravity flow to describe the roughness of a particular pipe material or condition. There has been much debate over the idea that the 'n' value of a pipe can change over time as the pipe ages and a slime layer grows on the pipe wall. One side of the debate claims that the roughness or 'n' value of this slime layer is the same whether the slime layer grows on a concrete wall, a vitrified clay wall, or a plastic wall. The other side of this debate proposes that a different 'n' value should be used for different pipe materials, generally ranging from 0.008 for plastic pipe to 0.016 for unlined concrete pipe (Jeppson, 1976) with vitrified clay pipe between the two values.

Hydraulic laboratory measurements of Manning's 'n' roughness coefficients on new pipe vary little between plastic and concrete pipe. May et al (1986) report values of 0.009 for plastic pipe to 0.010 for unlined concrete pipe. Bloodgood and Bell (1961) found an average Manning's 'n' for asbestos cement pipe of 0.0109. Straub et al (1960) reported values of 0.0106 for tamped concrete pipe and 0.009 for cast concrete pipe.

Table 4-2 shows the Manning's ‘n’ value used by various agencies. The majority of these agencies specify a Manning's ‘n’ of 0.013. Some sewerage agencies believe that after a period of time, the deterioration of the pipe surface and joints increase friction, and recommend that a higher ‘n’ value should be used in design. The City of Los Angeles requires an ‘n’ value of 0.014 in their design standards for sanitary sewers.

Table 4-2: Comparison of Manning’s ‘n’, Minimum Pipe Size, and Maximum Velocity Criteria of Various Agencies

AGENCY	MANNING’S *‘n’*	MINIMUM PIPE SIZE (in)	MAXIMUM VELOCITY [a] (fps)
Central Contra Costa Sanitary District	0.013	8	not specified
City of Los Angeles	0.014	8	not specified
Washington Suburban Sanitary Commission	0.013	8	15
City of Dallas	0.013	6	10
City of Phoenix	0.013	8	9
Clark County Sanitation District (NV)	0.013	8	10
City of Bellevue (WA)	not specified	8	10
Sacramento County (CSD-1)	0.013	8	not specified
City of Winters	**0.013**	**8**	**not specified**

a. Most agencies allow the maximum velocity to be exceeded if special design procedures are followed.

A Manning's ‘n’ design value of 0.013, the most widely accepted value in the industry, provides some degree of conservatism if, in fact, there is a significant benefit to the smoother plastic pipe and PVC-lined (T-lock) pipe walls. For the Winters Sewer Collection System Master Plan, it is recommended that an ‘n’ value of 0.013 be used for all pipe materials.

4.2.2 Minimum Pipe Diameter

Although there are some agencies that allow new 6-inch sewers (and many agencies, including Winters, that have substantial amounts of existing 6-inch pipe), a minimum sanitary sewer pipe size of 8-inches is generally accepted as the industry standard and is the current Winters design criteria. Therefore, except for service lines (laterals), the minimum acceptable gravity pipe diameter for all newly constructed pipelines in this Master Plan shall be 8 inches.

4.2.3 Maximum Allowable Flow Depth

Depending on the pipe size, three different criteria concerning the depth of flow are being used by major sewer agencies in California.

For smaller pipes, usually up to 12 or 15 inch in diameter, the depth of flow to pipe diameter (d/D) ratio of 0.7 or 0.75 is used for the design at peak flow. This lower (d/D) ratio is more conservative and is used to prevent flow blockages in smaller pipes due to debris and avoid potential backup into connected service laterals.

Larger pipes (18 inches and larger) are generally designed to flow full at design flow conditions. A pipe designed for full or 100 percent capacity has a d/D ratio of 1.0. Higher pipe capacities at d/D ratios of 0.8 to 1.0 will not be considered.

In order to save costs, some agencies allow surcharging of large diameter gravity flow sewers under peak flows associated with infrequent (long return period) storm events. The main disadvantage of this approach is that once surcharging is allowed, its extent is hard to control and may result in flooding of basements and other low lying areas, and low flow velocities that may cause solids to settle out in the pipe. Also, gravity sewers are not designed for pressure flows, and flows under surcharged conditions may result in some exfiltration of sewage.

For Winters' Sewer Collection System Master Plan, it is recommended that the maximum depth of flow at peak design conditions in any collector (10-inch diameter or less) shall be 0.7 of the pipe diameter. Sewers 12 inches in diameter and larger may be designed to flow full unless direct service connections are planned, in which case the 0.7 diameter maximum depth shall govern. This criterion is widely accepted and complies with proposed City improvement standards.

4.2.4 MINIMUM VELOCITY / SLOPE

For municipal wastewater with its associated grit and solids content, 2 fps is commonly used as the minimum design velocity at full or half full pipe flow conditions. When the sewers are less than half full, the velocities are below 2 fps. When the depth of sewage is greater than half full, the velocity increases above 2 fps until a maximum velocity is reached at approximately 94 percent of full pipe depth. From 94 percent depth to full pipe, the velocity decreases back to 2 fps.

Table 4-3 lists the full pipe velocity criteria used by various cities and agencies. The criteria were found in the respective standards or design manuals.

Table 4-3: Comparison of Minimum Velocity Criteria of Various Agencies

AGENCY	MINIMUM VELOCITY (fps)	CONDITION
Central Contra Costa Sanitary District	2 [a]	At half pipe and full pipe conditions.
City of Los Angeles	3 [b]	At peak dry weather flow that exists at the time the pipe is placed into service.
Washington Suburban Sanitary Commission	2.5 [c]	At half pipe and full pipe conditions.
City of Dallas	2	At half pipe and full pipe conditions.
City of Phoenix	2	At half pipe and full pipe conditions.
Clark County Sanitation District (NV)	2 [c]	At half pipe and full pipe conditions.
Sacramento County	2 to 3 [d]	At half pipe and full pipe conditions.

a. Minimum velocity in small sewers (8", 10" and 12") is required to be higher.
b. Minimum velocity in upstream terminal reach is allowed to be lower.
c. Minimum velocity in upstream terminal reach is required to be higher.
d. Minimum velocity is 2 fps for 8 to 18-inch, 3 fps for 39-inch plus, and varies from 2 fps to 3 fps between 21- and 36-inch.

Once a minimum velocity and Manning's 'n' are selected, the pipe slope can be calculated. Table 4 presents the minimum pipe slopes for various agencies for pipe sizes ranging from 8 to 36 inches. County Sanitation District 1 of Sacramento County (CSD-1) has over 2500 miles of mainline sewers and based on observed conditions in their various trunk sewers, they recently steepened their minimum required slopes for sewers greater that 18-inch. CSD-1 now requires that sewers 39-inches and greater have a minimum velocity of 3 feet per second (fps) at full pipe flow and that sewers from 21- to 36-inches in diameter transition from 2 fps to 3 fps. While this change in slope is minor, the decrease in maintenance requirements is noticeable.

Based on historical work order data and blockage reports, CSD-1 has determined that the terminal sewer reaches (sewers in cul-de-sacs for example) require more maintenance than downstream sewers. Although they have not yet modified their standards, they are considering steepening their required minimum slope for terminal sewer reaches. As shown in **Table 4-4**, various leading sanitation agencies currently require steeper terminal reaches. Until this requirement is more common in Northern California, we are not proposing this requirement for Winters.

Table 4-4: Minimum Pipe Slopes for Various Agencies [d, e]

Pipe Size (in)	Central Contra Costa Sanitary District	City of Los Angeles	Washington Suburban Sanitary Commission	City of Dallas	City of Phoenix	Clark County Sanitation District	Sacramento County (CSD-1)	Winters' Draft Design Standards
8	0.0077	0.0087 0.0044 [a] 0.0060 [b]	0.0050 0.0100 [c]	0.0033	0.0033	0.0033 0.0060 [c]	0.0035	0.0035
10	0.0057	0.0065	0.0040	0.0025	0.0024	0.0025	0.0025	0.0025
12	0.0022	0.0051	0.0030	0.0020	0.0019	0.0020	0.0020	0.0020
15	0.0015	0.0038	0.0019	0.0015	0.0014	0.0015	0.0015	0.0015
18	0.0012	0.0030	0.0015	0.0011	0.0011	0.0012	0.0012	0.0012
21	0.00095	0.00239	0.00120	0.00090	0.00092	0.00092	0.0012	0.00092
24	0.00080	0.00200	0.00100	0.00080	0.00077	0.00077	0.0011	0.00077
27	0.00070	0.00171	0.00102	0.00060	0.00066	0.00066	0.0010	0.00066
30	0.00060	0.00149	0.00089	0.00055	0.00057	0.00057	0.0010	0.00057
33	0.00055	0.00131	0.00078	0.00050	0.00050	0.00050	0.0010	0.00050
36	0.00050	0.00117	0.00070	0.00045	0.00045	0.00045	0.0010	0.00045

a. Minimum slope in upper reaches of system with few connections.
b. Minimum slope in upstream terminal reach.
c. Minimum slope in upstream terminal reach.
d. Agencies using 2 fps criteria: Sacramento County, Dallas, Phoenix, Clark County Sanitation District.
Agencies using 2.5 fps: Washington Suburban Sanitary Commission
Agencies using 3 fps: Los Angeles.
e. Agencies using Manning's 'n' coefficient =0.013: Sacramento County, CCCSD, WSSC, Dallas, Phoenix, CCSD.
Agencies using Manning's 'n' coefficient =0.014: Los Angeles.

Recommendations for Minimum Slopes and Velocities

Two criteria are recommended to determine the design minimum slopes for sewers in Winters. The first criteria requires the minimum design slopes (see Table 4-6) to provide a minimum velocity of 2 fps for sewers between 8 and 18 inches in diameter and a minimum velocity of 3 fps for sewers 39 inches and larger. For sewers between 21 and 36 inches, the minimum slope allows the velocity to transition from 2 fps to 3 fps. The velocities are calculated with Manning's 'n' =0.013 and full pipe conditions. The second criterion requires the design slope to provide a minimum velocity of 2 fps at peak dry weather flow at buildout. These criteria will minimize the possibility of inexperienced designers trying to meet depth requirements by oversizing the sewers and flattening the slope.

Recommended Minimum Slopes for Trunk Shed Plans

This Master Plan will recommend sewer trunks and describe the collection system configuration of areas in the City that will be developed in the future. These configurations may consist of sewer alignments that are fairly fixed (i.e. alignments along existing roads) and alignments that are schematic (i.e. alignments through large tracts of currently undeveloped land). Both the 'fixed' alignments and the schematic alignments may be changed during the design process. As a general rule-of-thumb, the length of collector sewer after construction (i.e., following actual subdivision streets) is typically about twice the length of the straight-line distance from the connection point to the trunk sewer to the farthest point in the sewershed. For this reason, it is desirable that a certain amount of flexibility be built into the trunk shed plan configurations. This flexibility can be represented by using slopes that are steeper than the minimum design slopes. **Table 4-5** presents the 'flexibility factors' used to modify minimum design slopes to compute minimum trunk shed slopes. **Table 4-6** presents the recommended minimum trunk shed slopes for 'fixed' (existing road) alignments and schematic (undeveloped land) alignments, compared to the minimum recommended design slopes.

Table 4-5: Basis of Minimum Trunk Shed Slopes (as Increase over Minimum Design Slope)

DIAMETER (in)	MINIMUM TRUNK SHED SLOPES	
	ALIGNMENT IN EXISTING ROAD	ALIGNMENT IN UNDEVELOPED LAND
8 to 10	Increase 0.0002 (1 foot per mile)	▪ 8" Sewer: Increase 0.0025 (2.5 feet per 1,000 ft) ▪ 10" Sewer: Increase 0.0010 (1 foot per 1,000 ft)
12 to 18		Increase 0.0004 (2 feet per mile)
21 to 36	Increase 0.0001 (6-inches per mile)	Increase 0.0002 (1 foot per mile)

Table 4-6: Recommended Minimum Slopes

DIAMETER (in)	MINIMUM DESIGN SLOPE [b]	MINIMUM TRUNK SHED SLOPES		
		ALIGNMENT IN EXISTING ROAD	ALIGNMENT IN UNDEVELOPED LAND [c]	DESIGN FLOW AT MINIMUM SLOPE (mgd) [a]
Collector Sewers				
8	0.0035	0.0037	0.0060	0.39
10	0.0025	0.0027	0.0035	0.59
12	0.0020	0.0022	0.0024	0.86
Trunk Sewers				
12	0.0020	0.0022	0.0024	1.03
15	0.0015	0.0017	0.0019	1.62
18	0.0012	0.0014	0.0016	2.35
21	0.0011	0.0012	0.0013	3.40
24	0.0010	0.0011	0.0012	4.63
27	0.0010	0.0011	0.0012	6.34
30	0.0010	0.0011	0.0012	8.39
33	0.0010	0.0011	0.0012	10.8
36	0.0010	0.0011	0.0012	13.6

a. Based on minimum design slope, Manning's '*n*' =0.013, and full pipe for trunk sewers and d/D = 0.7 for collector sewers.

b. Minimum design slope selected to provide a minimum velocity of 2 fps for sewers between 8 and 18 inches. For sewers between 21 and 36 inches the minimum slope allows the velocity to transition from 2 fps to 3 fps. Velocities calculated with Manning's '*n*' =0.013 and full pipe conditions. Slopes shown with two significant digits.

c. Slopes shown for 8- and 10-inch sewers will be used to check minimum depth of sewer at periphery of trunk shed. Length will be measured on a straight line from trunk sewer to the periphery of the trunk shed. Sewers 12 inches and larger will be shown in the 'best guess' location of future roads in the trunk shed.

4.2.5 MAXIMUM VELOCITY

As shown in Table 4-2, the maximum velocity used by various agencies generally ranges from 8 to 15 fps. For this Master Plan, a maximum velocity of 10 fps for gravity sewers is recommended.

4.2.6 Maximum Collector Sewer Depth

The City's Draft Improvement Standards do not address the maximum depth of sewer services or collector sewers. CSD-1 limits the maximum depth of sewer services to 16 feet which then limits the depth of collector sewers to 16 feet since sewer service lines connect to collector sewers. This restriction exists because the CSD-1 Maintenance and Operations group has the capability to make repairs to service lines and collector sewers to a depth of 16-feet with their own excavation and shoring equipment. Excavations deeper than 16-feet require the M&O group to hire an outside contractor to perform the necessary repairs. Since most sewer repairs occur on service lines and collector sewers, it was logical for CSD-1 to limit collector sewers to a maximum depth of 16-feet. Following similar logic, we recommend that the maximum depth for service sewers and collector sewers in Winters be limited to 16 feet.

For trunk sewers (sewer 15-inch and larger and 12-inch sewers without service sewer connections), we recommend that the maximum depth be evaluated on a case-by-case basis. In general, a maximum cover of 20 feet can be used. Where trunk sewers are deeper than 16 feet and there are service laterals that must be served, it is recommended that shallower collector sewers are constructed parallel to the trunk sewers.

4.2.7 Minimum Pipe Depth

When discussing the depth of a pipeline, two terms are used: depth and cover. Sometimes these terms are used interchangeably, but for the purposes of this Master Plan, the following definitions will be used:

- Depth: Distance from ground surface to invert of pipe.
- Cover: Distance from ground surface to crown (top) of pipe.

The deeper a gravity sewer is located, the more flexibility there is with respect to alignment and connection point selection for future upstream connections. If a gravity sewer is too shallow, future upstream development using gravity connections may be restricted, and a lift station may be required. For this reason, it is important to plan sewers at proper depths during the master planning process. For this Master Plan, it is recommended that a minimum depth of 7 feet be used for planning future sewers, including the sewers at the periphery of the system. The following procedure will be followed to confirm that this minimum depth criterion is met:

1. Delineate trunk shed boundary.
2. Using existing features such as roads and property lines, create plan view of sewer system skeleton within the trunk shed.
3. Calculate design flows.
4. Using design flows, calculate pipe sizes and slopes.
5. Connect far corners of trunk shed to trunk sewer skeleton using a straight line at the trunk shed minimum slopes (this represents a collector sewer serving the future development at the periphery of the trunk shed.) Check minimum depth at far corners as well as at all other locations in the trunk shed.

Due to topographic features such as canals, creeks, etc., there may be locations where the minimum depth criteria cannot be met. This will be considered acceptable as long the following two conditions are satisfied:

1. The length of the reach of pipe at less than minimum depth is relatively short (less than about 50 feet).
2. There is at least 4 feet of separation between the flow line of the creek or canal and the crown of the sewer. The flow line elevations will be based on either field survey data or flow line information from the recent Winters Drainage Master Plans. USGS topographic maps are not accurate enough to determine flow line elevations of canals/creeks for this purpose.

During the final design phase, details such as concrete encasement, pipe material, flotation caps, creek restoration details, hydroseed mixes, manhole setback distances, and trench plugs will be determined based on Winters' Design Standards and the depth of sewer, diameter of sewer, length of crossing, and permit requirements.

4.2.8 Design Requirements at Increases in Pipe Size

As design wastewater flowrates increase from upstream to downstream, it is necessary to increase the size of the sewer pipe. Pipe size increases are only allowed at manholes. There are several methods that may be used to determine the relative vertical alignment of the upstream and downstream pipes at changes in pipe size:

1. Match the elevation of the energy grade lines of the two pipes at the design flowrate.
2. Match the crown elevations.
3. Match the 2/3 diameter points.
4. Match the 0.7 diameter points.
5. Match the 5/6 diameter points.

Method 1 is the most rigorous and is usually only used during final design. Methods 3, 4, and 5 are quick approximations of Method 1. Method 2 is the most conservative and easiest to apply at the planning stage. Therefore for this Master Plan, method 2, matching crown elevations at pipe size increases, is recommended.

There may be locations in the collection system where two pipes of the same size connect together but the design flow in the branch pipe is significantly lower than that in the mainline pipe. At these locations, if the crown elevations are matched, the higher flow level in the main sewer will cause a backwater condition in the branch sewer. For this Master Plan, it is recommended that the branch sewer elevation be set 0.1 foot above the main sewer elevation when the branch sewer is the same size as the main sewer.

4.2.9 Headloss in Manholes

There are various approaches used to account for the headloss generated by manholes:

1. Every manhole (straight or deflection) is assigned a 0.1-foot drop.
2. Deflection manholes are assigned a minimum of 0.1-foot drop.
3. Calculation is made for each headloss component, including headloss due to change of direction, change of slope, and sidewall friction within the manhole, for pipelines with velocities greater than 3 fps.

Method 1 can be excessive except in areas with an abundance of available fall. Method 3 is too rigorous for a planning level analysis. For this Master Plan, Method 2 is recommended with these added clarifications: Deflection manholes with changes in direction greater than 20 degrees will be assigned a 0.1-foot drop. Deflections greater than 90 degrees are not allowed.

If a sewer increases in diameter in a deflection manhole, the invert elevation increases are not additive. For example, if two 12-inch sewers join in a manhole and discharge to an 18-inch sewer, the drop in invert elevation would be 0.5 feet (based on matching crowns), not 0.6 feet (0.5 feet + 0.1 feet for deflection).

4.2.10 Hydraulic Design Criteria for Force Mains

Pump stations and force mains should be avoided in sewage collection systems as much as possible but may become necessary to keep the collection system from becoming excessively deep. The hydraulic criteria for selecting the diameter of force mains are presented below.

Various agencies use different design criteria for minimum and maximum velocities in force mains. Sacramento County is currently writing a Pump Station Design Manual. **Table 4-7** presents the criteria from various agencies.

Table 4-7: Comparison of Force Main Velocity Criteria of Various Agencies

AGENCY	FORCE MAIN VELOCITY
Washington Suburban Sanitation District	▪ Maximum: 6 fps ▪ Minimum: 2 fps to keep solids in suspension, ▪ 3 to 3.5 fps to resuspend solids
City of Dallas	3 to 5 fps
City of Phoenix	3.5 to 6 fps

The maximum velocity in a force main is usually determined by balancing a number of factors including cost of the pipeline; cost of power usage (higher velocity results in higher headloss); and cost of pumps, motors, electrical equipment, and surge protection facilities. Given that the design flow rate for sewer force mains (PWWF at buildout) occurs infrequently, once every 10 years if the design storm is a 10-year storm, it is cost effective to set the maximum velocity at a high velocity since the daily peak flow rate is typically much lower. (For a typical water pump station, the daily flow rate is closer to the design flow rate, which tends to lower the cost effective maximum velocity for water transmission pipelines compared to sewage force mains.) For this Master Plan, a maximum force main velocity of 8 fps at PWWF is recommended.

Force mains connected to large pump stations (e.g., East Street Pump Station) flow constantly, whereas small pump stations, such as El Rio Villa pump station, pump intermittently, and the solids in the force mains can settle out during low flow periods as the wet well fills. This is especially true during the early startup years of a pump station before its upstream catchment area fully develops. To resuspend the solids that may settle out in the force main, a minimum velocity of 3.5 fps with one pump running is recommended for use in the Master Plan.

Most force mains are relatively flat and the 3.5 fps recommendation is applicable. A small number of pump stations pump uphill through force mains that are constructed on steep slopes. This adverse slope requires a higher sewage velocity to transport solids. Therefore, if a force main is steeper than 20 percent, additional analysis is required to determine the acceptable minimum velocity.

Dual Force Mains

To obtain the required velocities for both initial and ultimate design flow conditions, dual force mains may be needed. Dual force mains also have the ability to allow for future inspection and rehabilitation of the pipes, which generally cannot be adequately inspected or repaired without being taken off line and dewatered for up to 24 hours at a time

In most cases, dual force mains can be built in two stages, since initial flows are generally significantly lower than design flows at buildout. However, building dual force mains in two stages may not be prudent in locations where available space may not be available in the future or in locations where one-time construction is strongly preferred to minimize impacts to the environment (e.g., wetlands), costly mobilization (e.g., highway and river crossings), or disturbance to the public.

For this Master Plan, it will be assumed that all pump stations will have dual force mains of the same size. Each force main will be sized to carry half of the peak design flow at a maximum velocity of 8 fps.

Also, each force main must have sufficient capacity to carry the peak dry weather flow at buildout so that one force main can be dewatered and undergo inspection or rehabilitation. Since force main inspections and rehabilitation events are relatively rare, the maximum velocity criteria can be relaxed and increased to 10 fps for peak dry weather flows through a single pipe.

Headloss

The Hazen-Williams formula will be used for calculating the friction headloss of force mains. The Hazen-Williams roughness coefficient, C, varies with pipe material, velocity, size, and age. Sacramento County field studies have measured C factors ranging from 105 (Arden Pump Station 60-inch RCP force main) to 130 (Sailor Bar Pump Station 14-inch PVC force main). For this Master Plan, a roughness coefficient of C = 100 is proposed to be used for all pipe sizes and materials.

4.2.11 Inverted Siphons

The term siphon as used in wastewater practice refers to an inverted siphon or depressed sewer which dips below the hydraulic grade line to avoid obstructions and stands full of sewage even with no flow. Its purpose is to carry sewage under an obstruction and to regain as much elevation as possible after passing the obstruction. Inverted siphons should be avoided unless clearly necessary to cross under major obstructions such as rivers or large creeks, major utility pipelines, highways, etc., and other alternatives are significantly more expensive. Alternatives to inverted siphons include deeper gravity sewers and/or pump stations, a well as "D"-shaped or box sewers. There are currently no inverted siphons in the City of Winters' sewer system, and it is generally the City's preference to construct deeper sewers and/or pump stations to clear deep obstructions.

The approach used in this Master Plan when planning relief projects or future expansion projects will be to avoid inverted siphons whenever possible. If it becomes necessary to use an inverted siphon, the following approach will be used:

- The length of the downflow and upflow legs of the siphon will based on a maximum slope of 15 percent to allow floatables to be conveyed downward and solids to be conveyed upward. [source: City of Los Angeles Sewer Design Manual Figure F272]
- The upstream invert elevation will be calculated by adding 12 inches plus the pipe friction to the downstream invert elevation. (The 12-inch factor is a conservative factor used at the planning phase; during the design phase, detailed hydraulic calculations would be performed.)
- The pipe friction will be calculated using the Hazen-Williams formula with a 'C' coefficient of 100.
- The pipe barrel diameter will be determined based on the following three criteria [source: City of Los Angeles Sewer Design Manual]:

  – Minimum velocity of 3 fps at ADWF during early years of operation.

  – Minimum velocity of 4 fps at PDWF during early years of operation.

  – Minimum 8-inch pipe diameter.
- Two barrels will be assumed for each siphon.

CHAPTER 5 SEWER SYSTEM ANALYSIS & RECOMMENDATIONS

Chapter Synopsis: This chapter presents the results of the sewer system analysis that identifies wet weather conveyance and pumping capacity deficiencies. Improvements to the sanitary sewer system are identified based on the capacity deficiencies. The descriptions of the individual projects and the rationale for identifying improvements are also discussed. There are three types of sewer projects: existing sewer conveyance capacity improvements, pump station and force main improvements, and future expansion of the existing system. One existing sewer conveyance capacity improvement project, eight pump station and force main expansion projects, and eleven future sewer expansion projects were identified.

5.1 Existing Wet Weather Conveyance Needs

This section presents the criteria used to determine conveyance and pumping capacity deficiencies, and identifies the potential conveyance and pumping deficiencies under existing and buildout flow conditions.

5.1.1 Capacity Deficiency Criteria

Table 5-1 summarizes the criteria that were used to evaluate the model results to determine conveyance and pumping capacity deficiencies. Note that evaluation criteria for master planning are not the same as design criteria and cannot be interchanged.

Table 5-1: Capacity Deficiency Criteria

	CAPACITY DEFICIENCY CRITERIA
Conveyance	A pipe is considered deficient if either or both of the following conditions are met at peak hour with design flows: [a] 1. There is potential for manhole overflow [b] 2. The ratio of the modeled design flow to the calculated pipe hydraulic capacity [c] exceeds 1.2 and there is more than 4 feet of surcharging [d]
Pumping	A pump station is considered deficient if its firm capacity [e] is less than calculated design flows [a]

a. Peak flows established in Chapter 3.
b. It is assumed that there is potential for manhole overflow if the hydraulic gradeline is less than 3 ft. below the ground surface. This definition accounts for potential error in rim elevation data and model accuracy. This criterion is of primary importance: a manhole overflow could represent public health risk, carries significant fines imposed by the Regional Water Quality Control Board, and could result in increased regulatory scrutiny through the State's pending statewide WDR regulations involving additional overflow reporting.
c. The hydraulic capacity is calculated based on the physical characteristics of the pipe and does not account for reduced capacity due to root intrusion, excessive grease accumulation, or debris. The City is responsible to ensure that 100% of the pipe capacity is available for wastewater flow.
d. Criterion allows existing system to operate under surcharge conditions for short period of time during peak wet weather flow.
e. Firm capacity is the capacity of the pump station with the largest pump not operating.

5.1.2 Conveyance Capacity Deficiencies & Recommendations

The H_2OMap Sewer hydraulic model of the existing collection system was run under the existing and buildout flow conditions defined in Chapters 2 and 3. A proposed citywide layout of future sewers and pump stations was then added to the City's existing collection system for analysis of future land use scenarios based on inputs from the City, the Draft Drainage Master Plans, and the proposed Winters Highlands and Callahan Estates developments. Load allocations for the future sewer collection system were presented in Figure 3-3. Potential wet weather conveyance capacity deficiencies were then identified based on criteria established in Table 5-1.

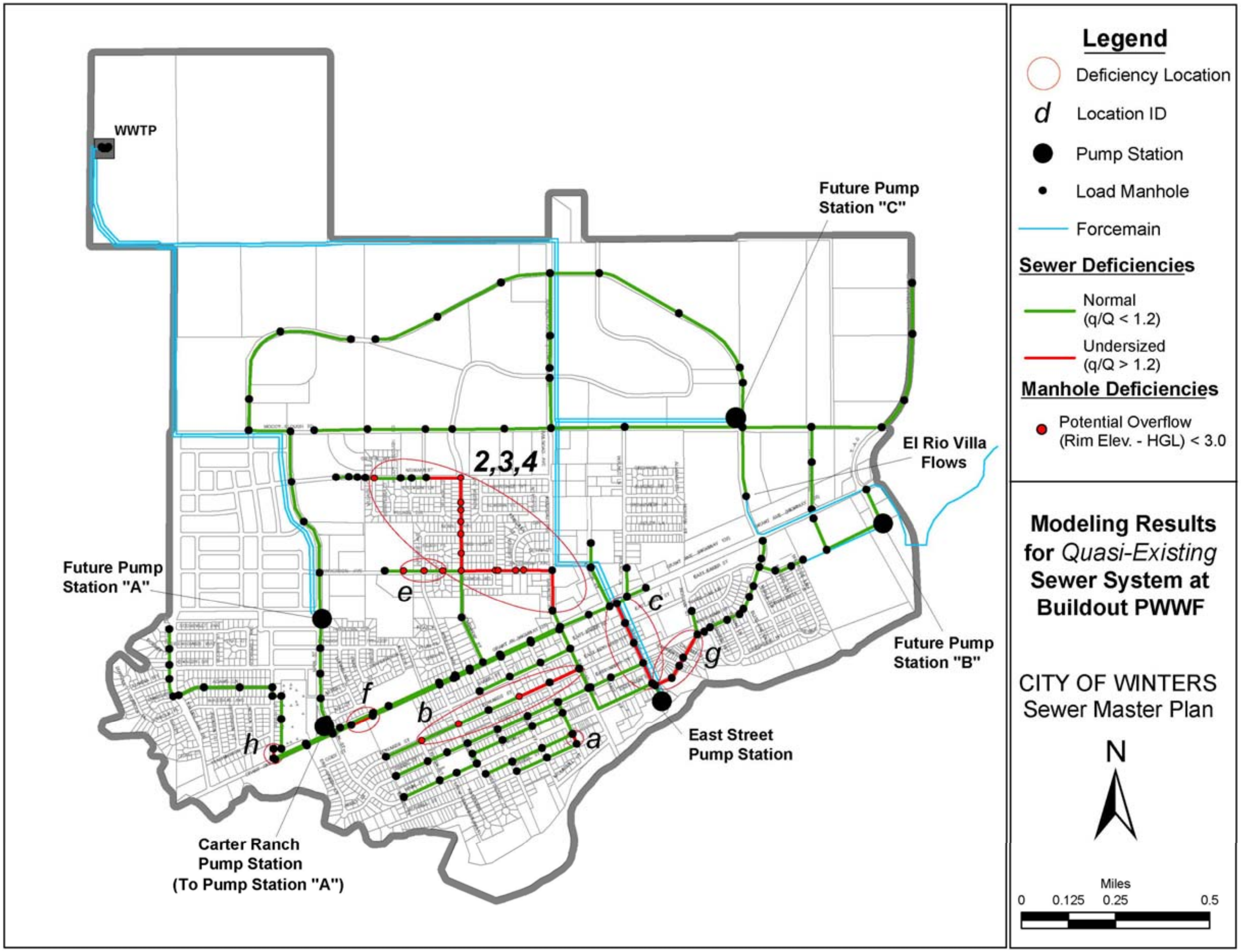
Figure 5-1 presents a layout of future sewers, pump stations, and locations of identified potential wet weather conveyance capacity deficiencies for the *quasi-existing*[6] sewer collection system under buildout PWWF conditions. Following discussion of the quasi-existing system, a similar figure, **Figure 5-12**, is presented for the recommended future collection system. For both systems, identified deficiencies are grouped together into locations and are either numbered (if a project is recommended) or lettered (if a project is *not* recommended).

Under both quasi-existing and recommended future conditions, there are eight locations where pipelines or manholes showed a potential deficiency. The capacity deficiencies, pipe characteristics, and hydraulic profiles for both recommended and non-recommended projects are presented in the sections below. In general, replacement pipes were preferred over parallel pipes in recommending projects for the existing sewer collection system because:

1. The difference in the parallel and replacement pipe was generally only one or two diameters;
2. Long-term maintenance is more efficient with fewer pipes and manholes in the system; and
3. Underground utility congestion is minimized with fewer pipes.

[6] The term "quasi-existing," as it is used in this and in subsequent sections, refers to a skeletonized sewer network that features the City's existing configuration, plus recommended expansion sewers and pumping stations intended to serve those portions of the study area that are currently undeveloped (North of Moody Slough Road, for example). The quasi-existing system does *not* include relief sewers or other capacity improvement projects that would address the potential deficiencies under buildout PWWF conditions. Analysis of the quasi-existing system is intended to highlight the need for certain capacity improvements and to compare results before and after the implementation of capacity improvement projects.

Figure 5-1: Potential Wet Weather Conveyance Capacity Deficiencies Location



5.1.2.1 Capacity Deficiencies under Quasi-Existing Conditions

The deficiencies and pipe characteristics for eight locations under quasi-existing conditions are summarized in Table 5-2 below.

Table 5-2: Capacity Deficiencies and Pipe Characteristics under Quasi-Existing Conditions [a]

PIPE ID [b]	STREET	DIAMETER (in)	LENGTH (ft)	DEPTH (ft)	CAPACITY DEFICIENCIES (q/Q) c
LOCATION *a*					
SP-1132	First Street at Russell Street	6	155	9	1.342
LOCATION *b*					
SP-1080	Edwards Street west of Railroad Avenue	6	465	10	1.279
SP-1078	Edwards Street west of First Street	6	470	7	1.205
LOCATION *c*					
SP-1178	East Street northwest of East Abbey St.	18	315	13	1.232
SP-1180	East Street northwest of East Edward St.	18	310	12	1.445
LOCATION *2-4*					
From SP-2204 to SP-2292	Neimann St. west of Hemenway St. to Railroad Ave. north of Grant Ave.	6 to 8	3,660	varies	varies; up to 1.7
LOCATION *e*					
SP-2174	Anderson Ave. west of Hill Pl.	8	265	6	0.259
SP-2172	Anderson Ave. west of Apricot Ave.	6	280	5	0.899
LOCATION *f*					
SP-1290	Grant Avenue northeast of Main Street	10	330	8	--
LOCATION *g*					
SP-1286	East Main Street east of East Street	10	260	17	1.435
SP-1284	East Main Street east of East Street	10	240	17	1.396
SP-1282	East Main Street east of Lauren Court	10	125	15	1.377
SP-1280	East Main Street east of Caselli Court	10	340	14	1.349
LOCATION *h*					
SP-2104	Taylor Street at Grant Ave.	8	135	9	1.257
LOCATION *i*					
SP-2106	Main Street north of Ivy Loop	8	410	17	1.221

a. Quasi-existing refers to a skeletonized sewer network featuring the City's existing configuration, plus recommended expansion sewers and pumping stations intended to serve those portions of the study area that are currently undeveloped. The quasi-existing system does not include relief sewers or other capacity improvement projects that would address the potential deficiencies under buildout PWWF conditions.

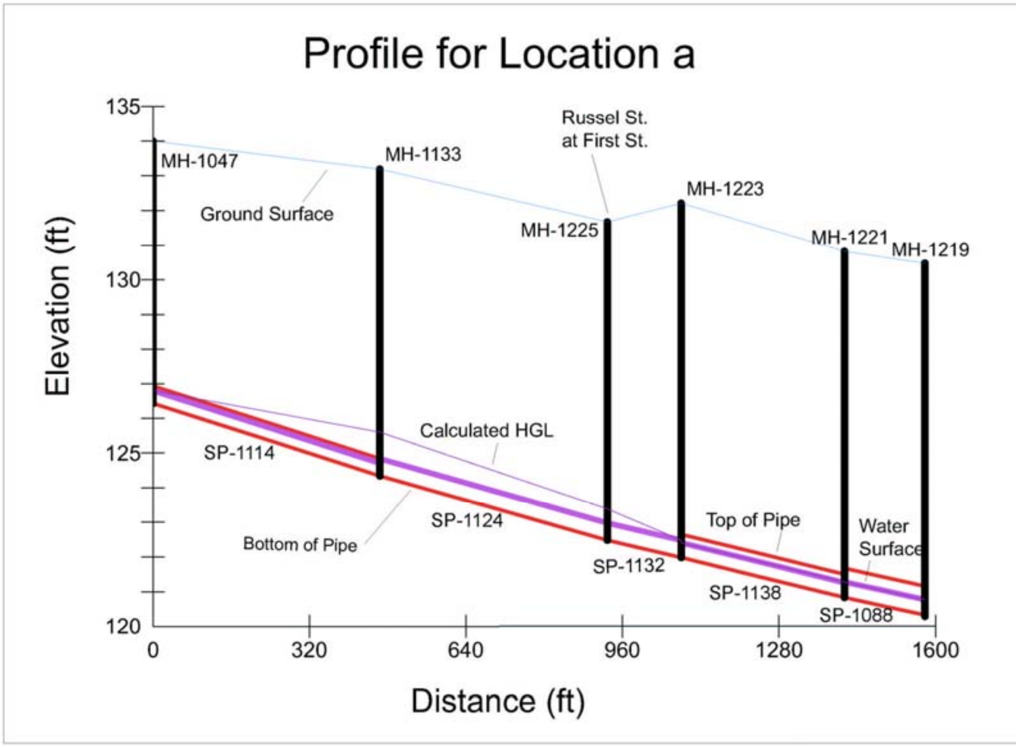
b. Refers to H_2OMap Sewer numbering system.

c. Expressed as ratio of the modeled design flow to the calculated pipe hydraulic capacity.

Each of the locations listed in Table 5-2 is described in further detail below.

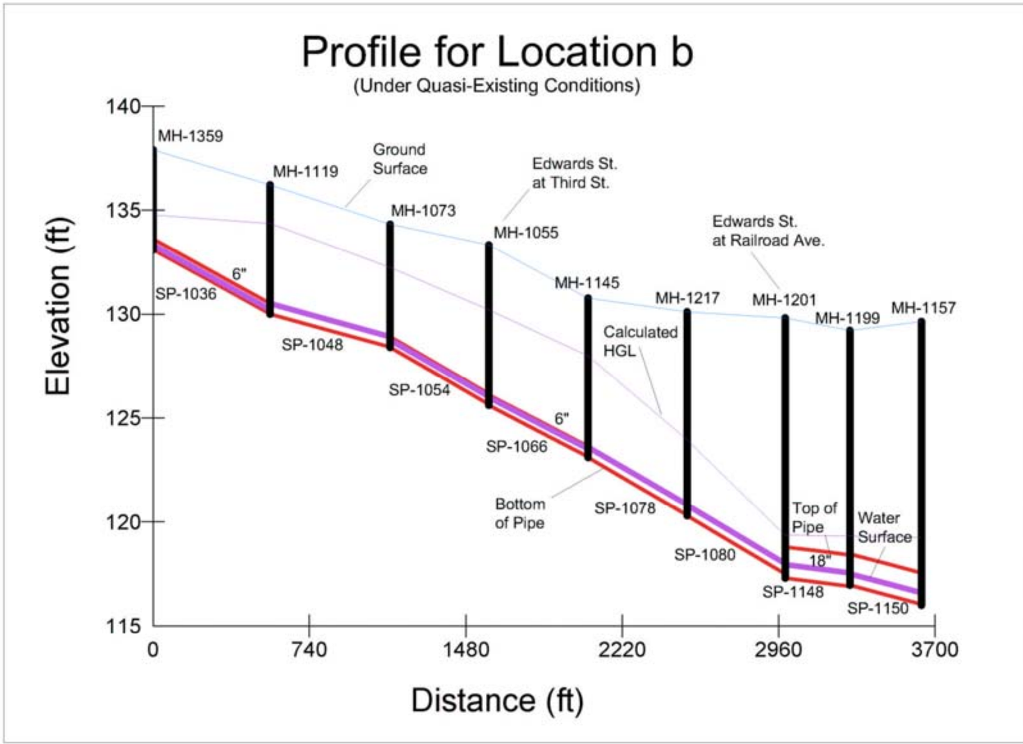
Location a – The sewer of interest for this location consists of one 6-inch sewer segment on First Street (SP-1132) that is approximately 134% over capacity. This deficiency could be resolved by upsizing this 155 foot segment to an 8-inch sewer to match the downstream sewers. However, this pipe is relatively deep (at 9 feet) with a low risk of causing an overflow and the surcharging is localized. Additionally, construction of a recommended capacity improvement project (Project 20) will partially alleviate this deficiency. Therefore, it is recommended that the City does not pursue this project.

Figure 5-2: Profile for Location a



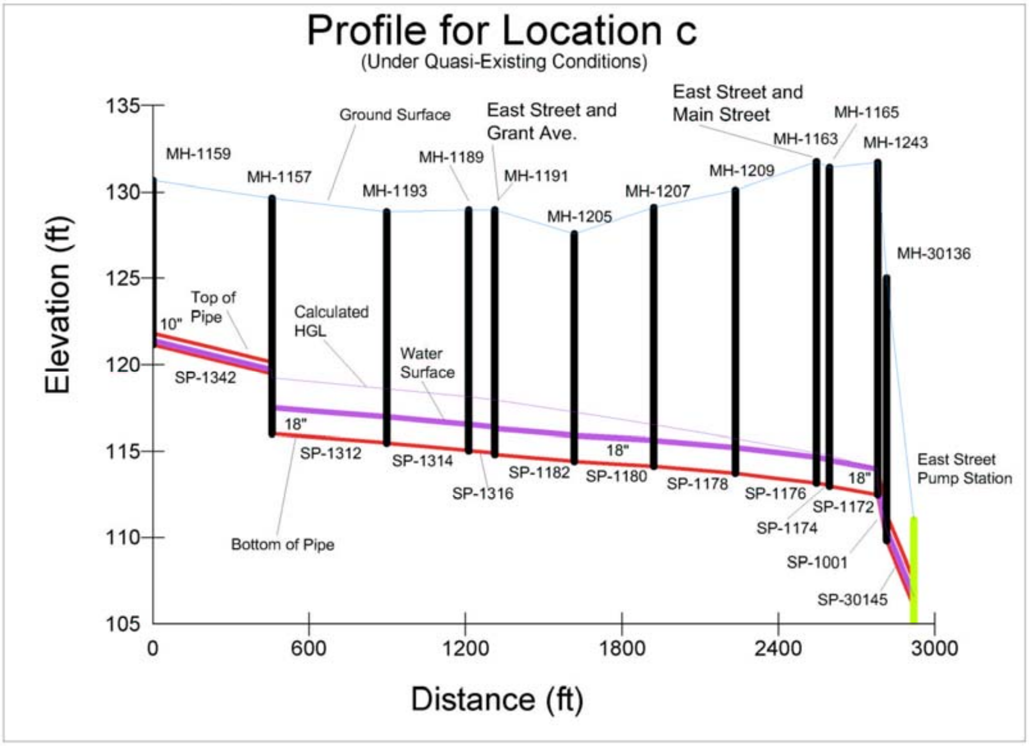
Location b – This location consists of two 6-inch sewers (SP-1078 and SP-1080) along Edwards Street at approximately 120% and 128% of capacity, respectively. As shown in **Figure 5-3**, localized surcharging to within 3 feet of ground level is possible at several of the manholes at this location, even with flows from the undeveloped Creekside Estates development routed to the 10-inch sewer on Grant Avenue. These potential deficiencies could be resolved by upsizing the Edwards Street sewers to 8-inches, or by freeing up additional capacity in the sewers downstream in Railroad Avenue. See Section 5.1.2.3 for additional discussion.

Figure 5-3 Profile for Location b:



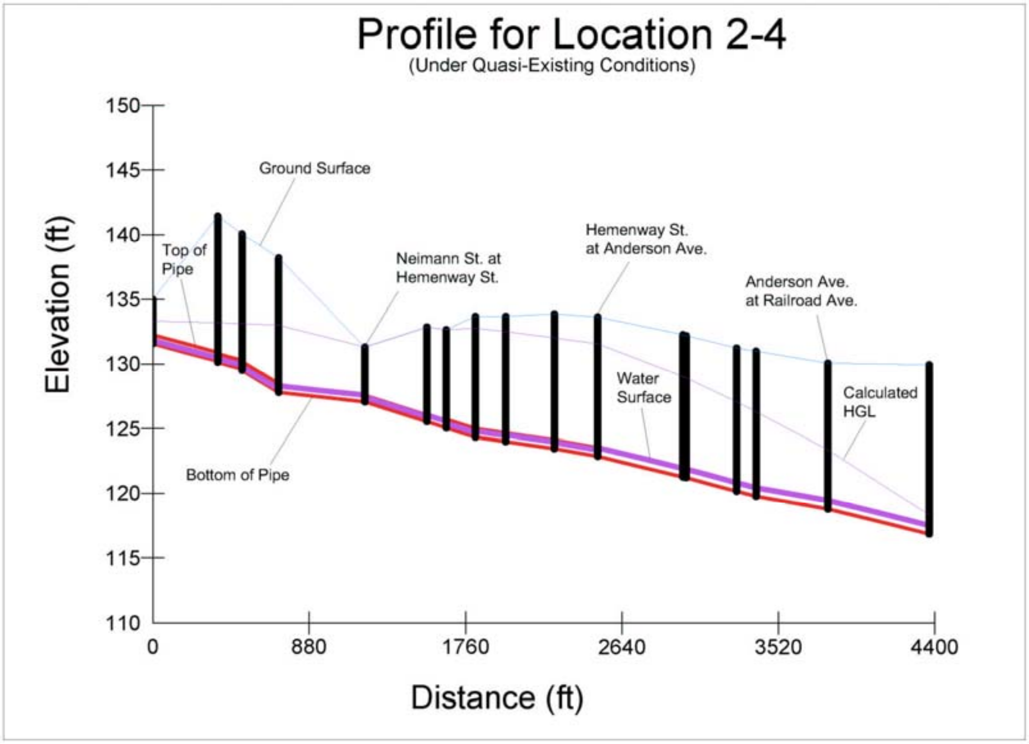
Location c – Approximately 1,100 feet of 18-inch sewer is undersized on East Street, between Morgan Street and Grant Avenue, with two segments (SP-1180 and SP-1178) having a q/Q greater than 1.2. This sewer currently conveys flows, including the 155 gpm flows from El Rio Villa, to the East Street Pump Station. These deficiencies can be partially resolved by diverting El Rio Villa flows north to Future Pump Station C, as shown in **Figure 5-4.**

Figure 5-4: Profile for Location c



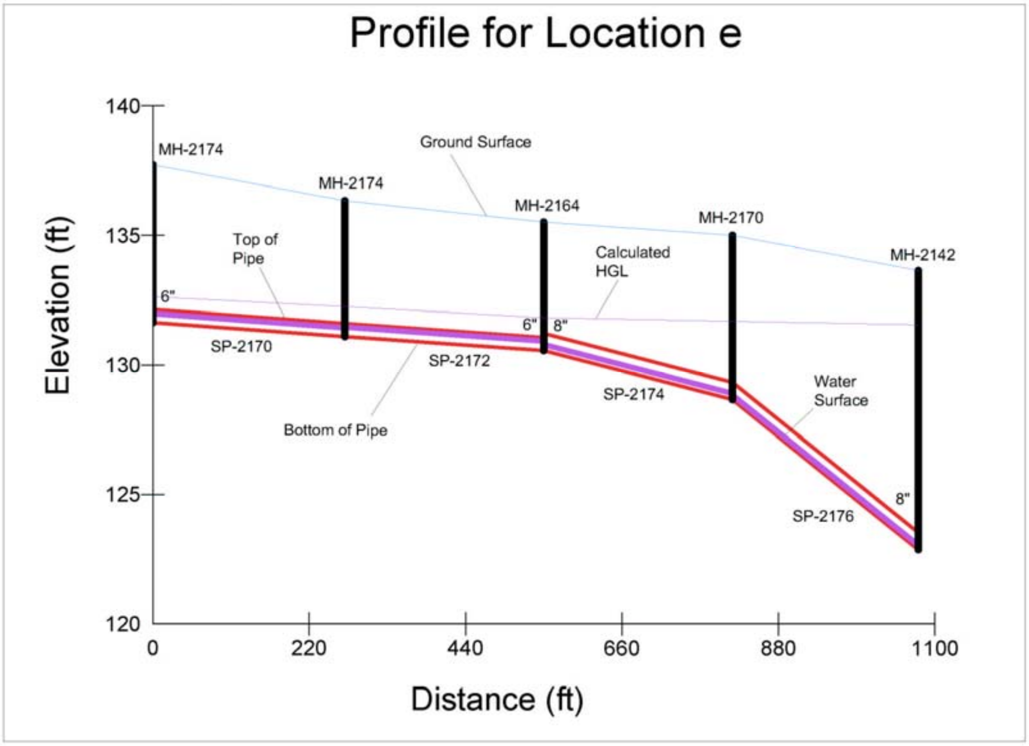
Location 2-4 – The segment that comprises Location 2-4 (from MH-2178 to MH-2120) consists of a series of 6- and 8-inch sewers spanning Neimann Street, Hemenway Street, Anderson Avenue, and Railroad Avenue. A number of these sewers are undersized, resulting in surcharging and backwater effects that affect the entire segment. These deficiencies could be resolved by either upsizing existing sewers in Neimann, Hemenway, Anderson and Railroad, or by rerouting flows from Hemenway at Neimann to an expansion project along Neimann, Railroad and Dutton (Project 4 on Figure 5-28). Refer to Section 5.1.2.2 for a description of the recommended projects. See Profile P3 (Section 5.1.2.5) for this same sewer after the recommended projects are constructed.

Figure 5-5: Profile for Location 2-4



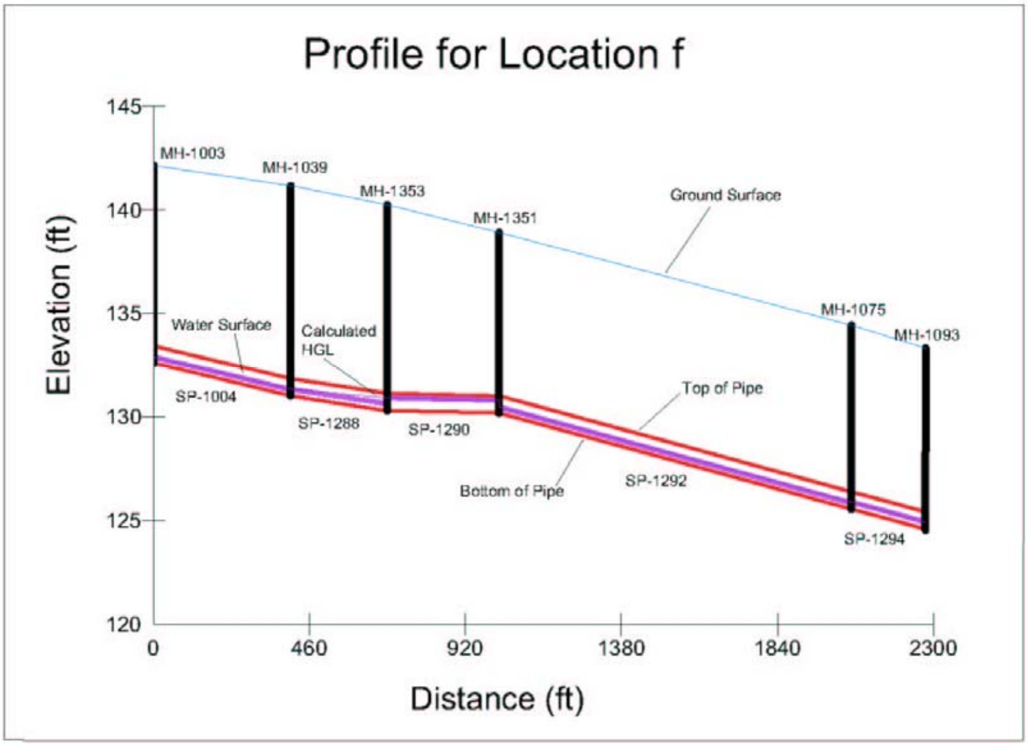
Location e – Due to backwater effects from Location 2-4, surcharging is possible in the manholes identified in Location e. Although the pipes in Location e have adequate capacity to convey flows from this segment, the calculated HGL for the segment exceeds the 3-foot criteria. This problem will be resolved by the construction Projects 1 through 4 (see Section 5.1.2.2).

Figure 5-6: Profile for Location e



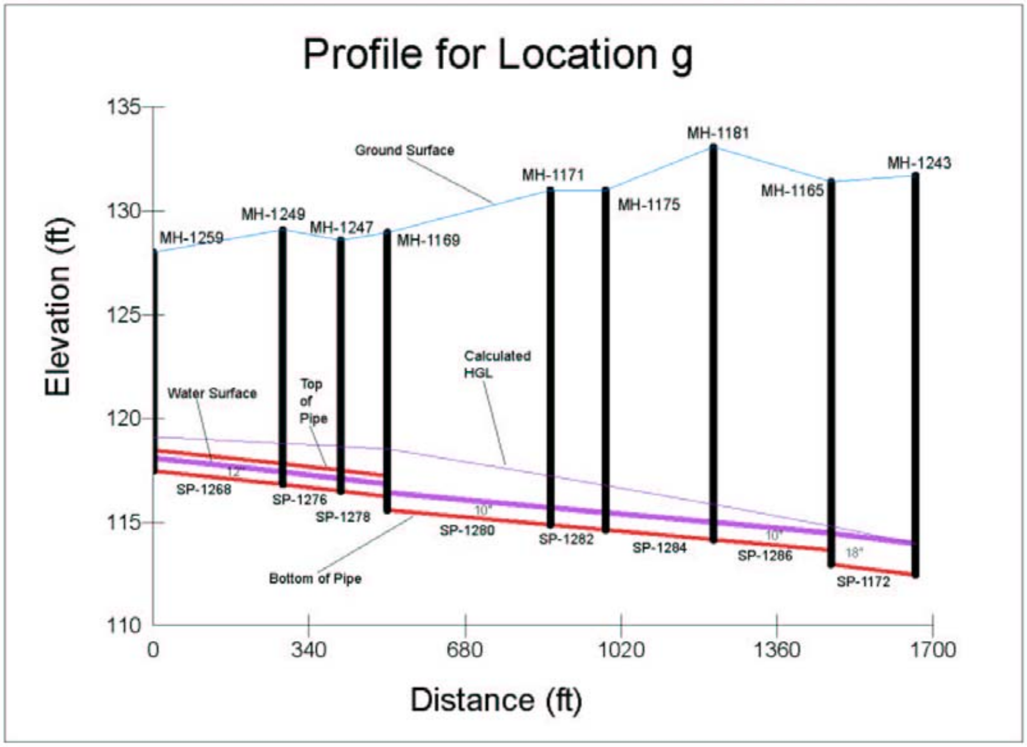
Location f – As shown in **Figure 5-7**, pipe SP-1290 is a flat 10-inch sewer on Grant Avenue. The slope for this sewer could not be verified through existing records and survey data. Hence, it is recommended that the City investigate/survey sewer slopes for this area and perform further analysis before pursuing any corrective project.

Figure 5-7: Profile for Location f



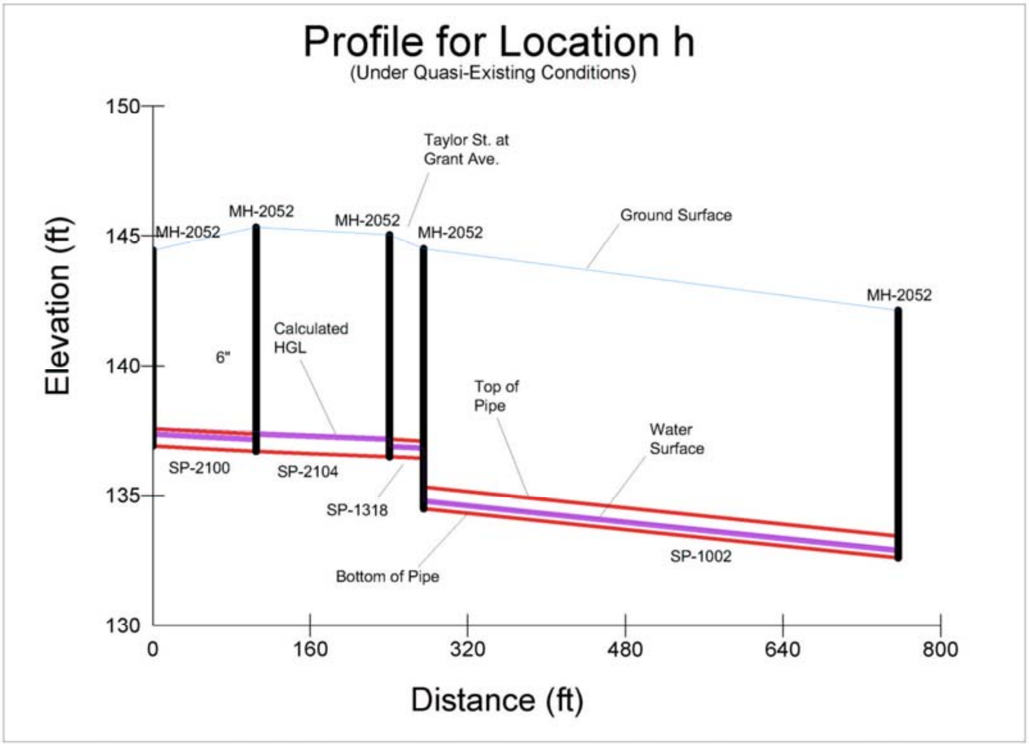
Location g – The deficiency for Location g consists of four 10-inch sewers on East Main Street immediately east of East Street to Morgan Street. These undersized sewers cause a bottleneck that reaches the corner of East Main Street and Morgan Street. However, due to only minor surcharging (i.e., one to two feet) in these sewers, and the fact that these sewers are at least 10 feet deep, the chance of an overflow is minimal. Hence, no project is recommended for Location g.

Figure 5-8: Profile for Location g



Location h – This location consists of one 8-inch sewer (SP-2104) at approximately 126% of capacity. This deficiency is resolved by the construction of Project 5, which diverts flow north at Adams Lane and Taylor Street.

Figure 5-9: Profile for Location h



5.1.2.2 Recommended Capacity Improvement Projects

Based on the analysis of the quasi-existing system, several capacity improvement projects are recommended to address the capacity deficiencies identified in the previous section. The following section discusses the logic behind these capacity improvement projects.

Projects 1-4

The construction of a diversion sewer to reroute flows from the Hemenway Street sewer (Projects 1 through 4 in Figure 5-28) will eliminate the capacity deficiencies previously described for the sewers along Neimann Street, Hemenway Street, Anderson Avenue, and Railroad Avenue. New sewers will divert flows at Neimann and Hemenway and will serve the parcels along Neimann, Railroad, and a portion of Dutton Street (Project 3 in Figure 5-28). For this solution to work, existing sewers in Dutton must be reconstructed at a different slope and with a larger diameter (Project 1 in Figure 5-28). A deep local collector sewer will serve the undeveloped parcels on the north side of Neimann Street (Project 4 in Figure 5-28), and a new lift station (Project 2 in Figure 5-28) will lift flows in the deep sewer into the new sewers of Project 3.

Figure 5-5 and 5-15 depict the sewers along Railroad Avenue, Anderson Avenue, Hemenway Street, and Neimann Street before and after the recommended projects are constructed.

The pipe profile shown in **Figure 5-10** demonstrates the necessity of Project 1, as it presents the future flow conditions if the existing sewers in Dutton Street are not reconstructed.

Figure 5-10: Profile for Location 1 (Quasi-Existing Conditions)

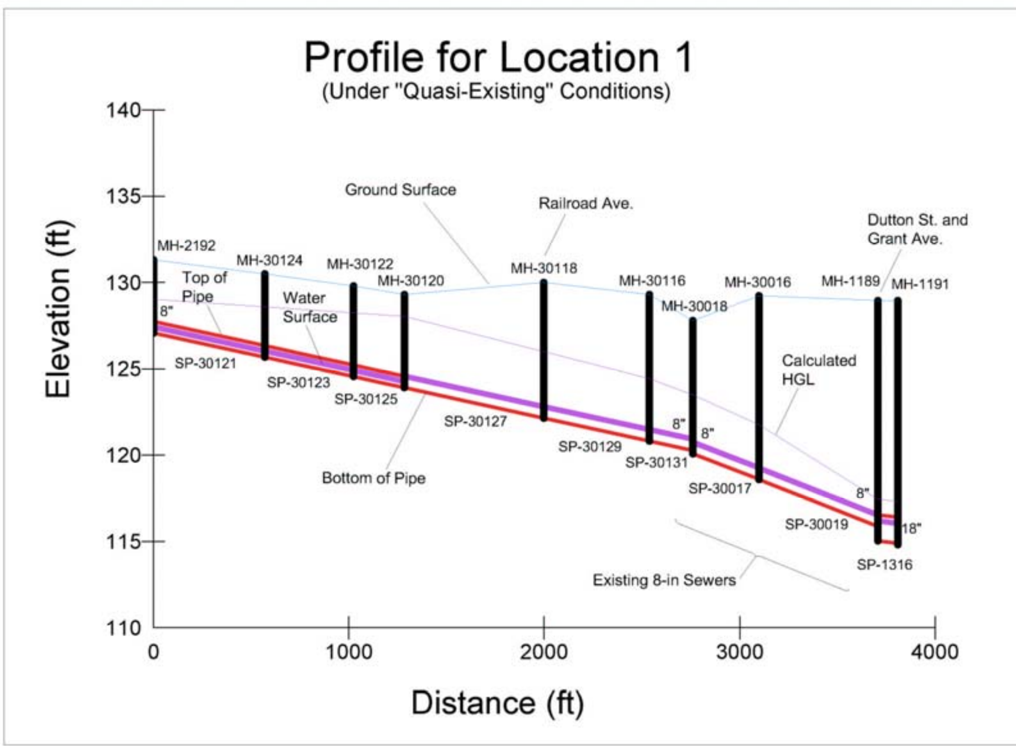
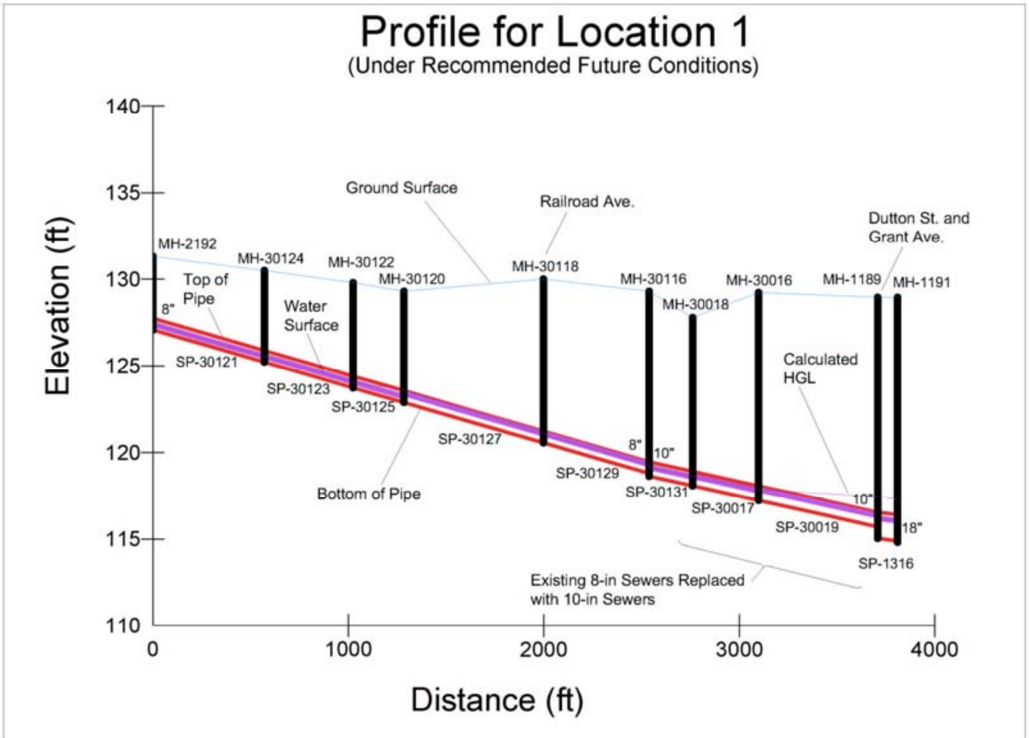


Figure 5-11 shows conditions after the reconstruction of the existing sewers in Dutton Street.

Figure 5-11: Profile for Location 1 (Recommended Future Conditions)



Project 5

By constructing Project 5, which consists of a new sewer from Adams Lane at Taylor Street to Main Street at Ivy Loop, flows from portions of the presidential streets area will be diverted north to Future Pump Station A. This flow diversion will alleviate or eliminate several of the capacity deficiencies discussed in Section 5.1.2.1 (Locations b, c, h and f), and will reduce the total flow entering the East Street Pump Station.

El Rio Villa Flow Reroute

By rerouting the 155 gpm flows from El Rio Villa, the total flow entering the East Street Pump Station will be further reduced. Additionally, several capacity deficiencies outlined in Section 5.1.2.1 (Locations b and c) will be alleviated by this reroute.

Project 20

In conjunction with Project 5 and the reroute of El Rio Villa Flows, Project 20 helps reduce the impact of several capacity deficiencies outlined in Section 5.1.2.1 (Locations b and c) by providing a shorter travel distance for much of the flow south of Abbey Street.

5.1.2.3 Modeling Results for Recommended Future System

Figure 5-12 presents the modeling results for the recommended future collection system during buildout peak wet weather conditions. The system shown in Figure 5-12 includes the capacity improvement projects described in the previous section. Results, including notable remaining capacity deficiencies, are discussed in further detail below.

Location 1 (Project 1) – This location consists of two 8-inch sewers (SP-30017 and SP-30019) on Dutton Street north of Grant Avenue. Under buildout conditions, these sewers receive flow from a series of proposed expansion pipes to the north and west. In their current configurations, these pipes are at approximately 143% and 168% of their capacities, respectively. The resulting surcharging, shown previously in Figure 5-10, is considered unacceptable. As discussed in Section 5.1.2.2, it is recommended that the City replace this 1,170 foot stretch of pipe with 10-inch pipes at a slope of 0.0025 (See Figures 5-10 and 5-11). These two segments are connected to a larger project that begins upstream at Neimann Street and Hemenway Street (see Project 2 on Figure 5-28).

Location b – With the construction of Project 20, both the extent and the severity of the capacity deficiencies described previously for this location are reduced. Two 6-inch sewers (SP-1078 and SP-1080) along Edwards Street are still undersized, however, and flow at approximately 125% of capacity. As shown in **Figure 5-13**, localized surcharging to within approximately 4 feet of ground level is possible, even with flows from the undeveloped Creekside Estates development routed to the 10-inch sewer on Grant Avenue. However, because the Creekside Estates parcels will not deliver additional flows to the Edwards Street sewer (see Section 5.1.2.4 below), and because surcharging does not exceed the 3-foot criteria, it is recommended that the City does not pursue this project at this time, but instead perform flow monitoring to confirm the flows in this area.

Figure 5-13: Profile for Location b

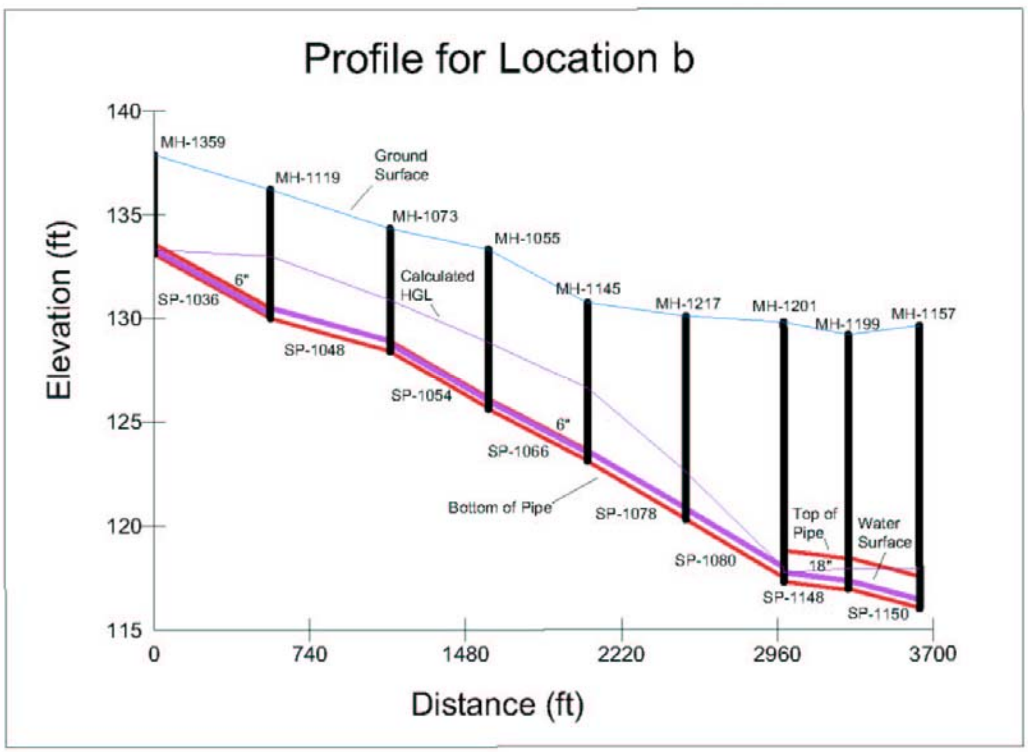
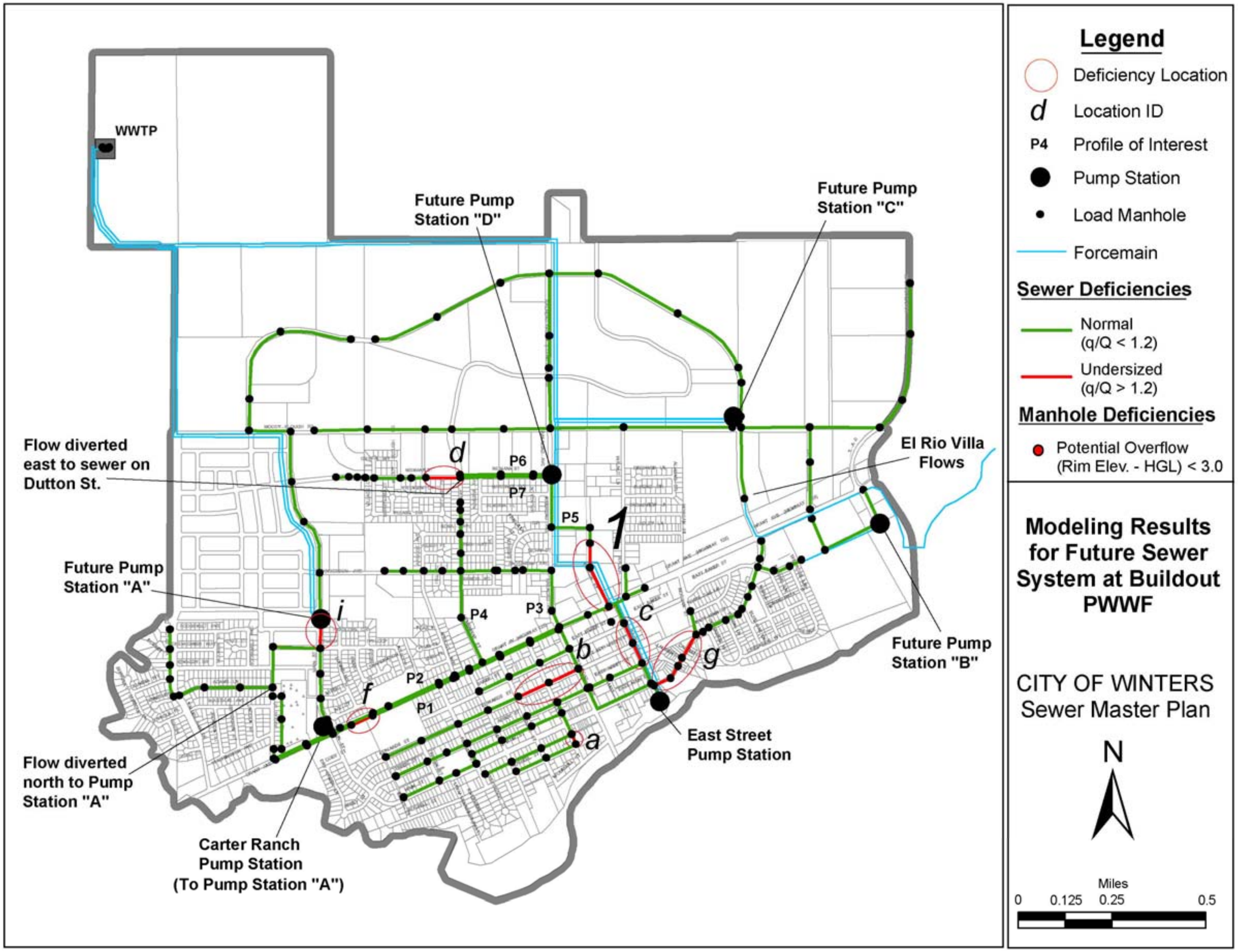
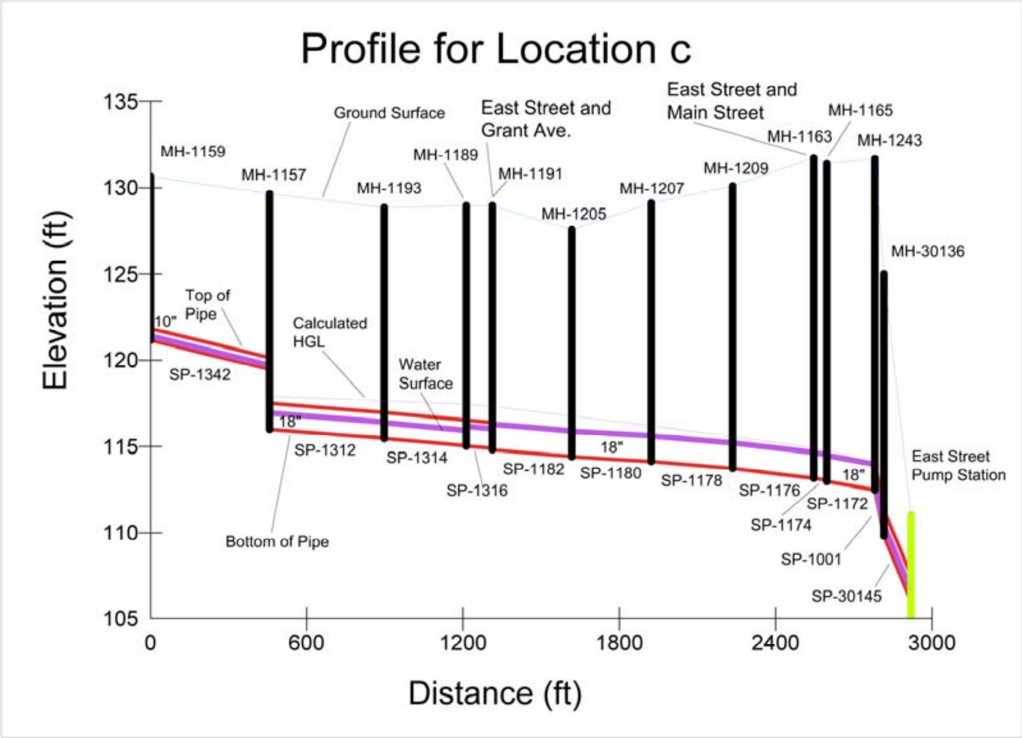


Figure 5-12: Modeling Results for Recommended Future Collection System



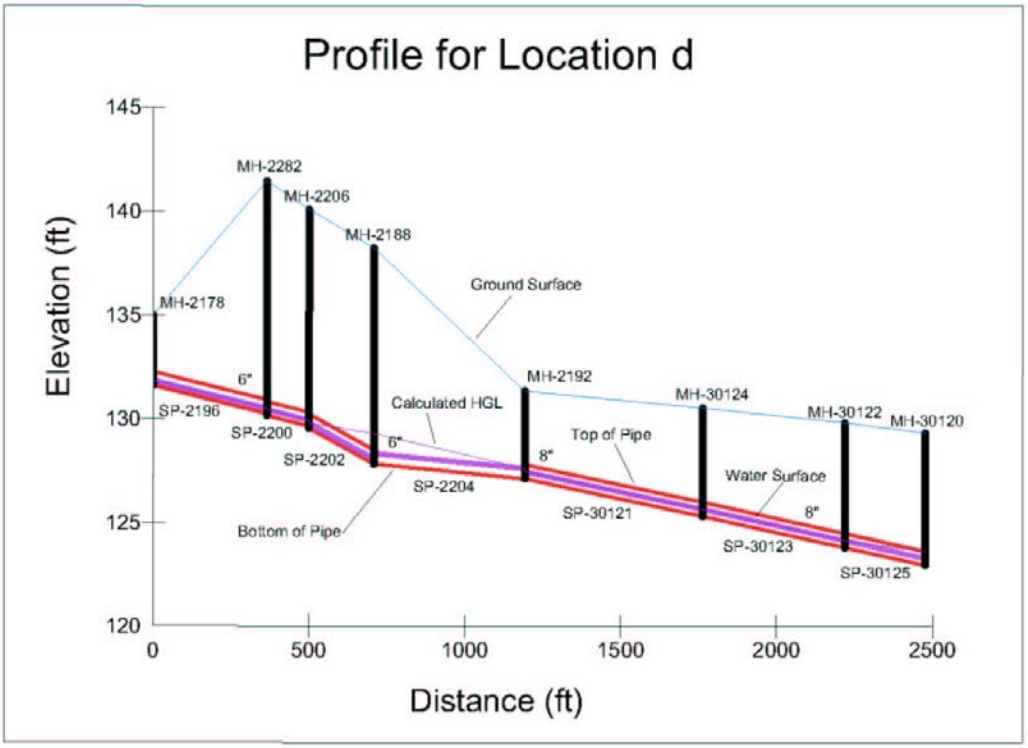
Location c – Even with El Rio Villa flows diverted north, Location c still shows a potential deficiency under the buildout PWWF scenario. The profile (**Figure 5-14**) for the 18-inch sewers at this location shows that they are relatively deep (at 12 feet) with a low risk of causing an overflow, since the calculated HGL is approximately 11 feet below the ground surface. In addition, surcharging is localized. Therefore, it is recommended that the City does not pursue any project for this location.

Figure 5-14: Profile for Location c



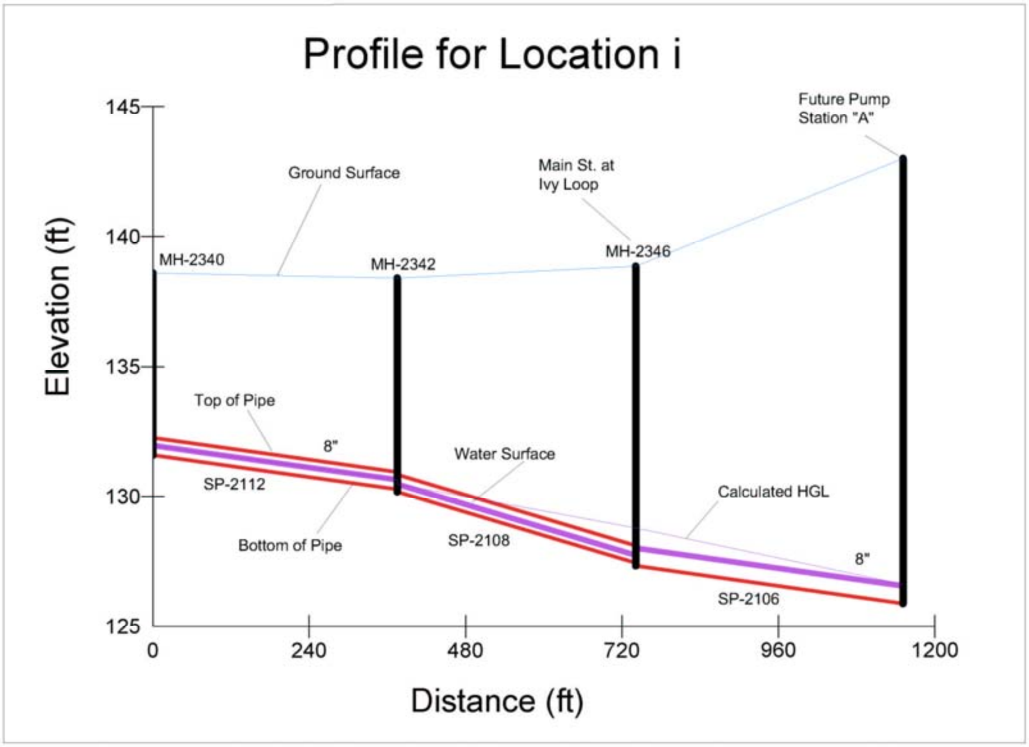
Location d – Although the extent and severity of capacity deficiencies at this location are reduced dramatically by the construction of Projects 1-4, there is still one 6-inch sewer (SP-2204) on Neimann Street at approximately 153% of capacity. Although this deficiency could be resolved by upsizing the 485 foot segment to 8-inches, possible surcharging at this location is minimal (approximately 9 feet below ground level) and does not appear to be an issue. No projects are recommended for this location.

Figure 5-15: Profile for Location d



Location i – This location consists of one 8-inch sewer (SP-2106) flowing north on Main Street. This pipe flows at approximately 122% of capacity, and occurs only after the construction of Project 5. Flows in this sewer drain directly into Future Pump Station A, at the southwest corner of the proposed Callahan Estates development. This deficiency could be resolved by upsizing the 410 foot segment to a 10-inch sewer, but since surcharging at this location is both localized and minimal (approximately 10 feet below ground level), no project has been recommended for this location.

Figure 5-16: Profile for Location i



Based on the results presented in this section, Project 1 has been recommended to address the deficiencies of the existing sewers at Location 1. The deficiencies and pipe characteristics for Location 1 are summarized in Table 5-3 below.

Table 5-3: Recommended Projects for Existing Sewers: Capacity Deficiencies and Pipe Characteristics

PIPE ID [a]	STREET	EXISTING DIAMETER (in)	LENGTH (ft)	CAPACITY DEFICIENCIES (q/Q) [b]	RECOMMENDED RELIEF DIAMETER (in)
Project 1 – Dutton Street Sewer Upsize					
SP-30017	Dutton St. north of Grant Ave.	8	610	1.432	**10**
SP-30019	North of SP-30019	8	340	1.678	**10**

[a] Refers to H_2OMap Sewer numbering system.
[b] Expressed as ratio of the modeled design flow to the calculated pipe hydraulic capacity.

5.1.2.4 Additional Capacity Evaluations and Recommendations

Creekside Estates Analysis – Based on hydraulic modeling analyses for several loading configurations for the undeveloped Creekside Estates development, it has been determined that it is both feasible and realistic to convey flows from the proposed development to the existing 10-inch sewers on Grant Avenue, rather than to the existing 6-inch sewers on Edwards Street. After diverting flows at Adams Lane and Taylor Street to Future Pump Station A, sufficient capacity will be created in the 10-inch sewer in Grant Avenue to accommodate future Creekside flows in that sewer.

Manhole Reconfiguration for Southwest Area Sewers Project (Project 5) – Existing sewer SP-2088, a 120 foot 8-inch pipe that currently links the 8-inch sewer on Adams Lane to the 8-inch sewer serving the trailer park on Grant Avenue, will no longer be used to convey flows for portions of the presidential streets area to the sewers on Grant Avenue, as flows from these parcels will be routed north in the future towards Future Pump Station A. In order to ensure that flows from this area travel north as intended on Taylor Street, it is recommended that MH-2094 be reconfigured (or that a new manhole is constructed just upstream). The future configuration of MH-2094 should resemble a broadcrested weir, which will prohibit daily flows from upstream areas from flowing south on Taylor, yet allow surcharged flows due to downstream blockage or mechanical malfunction to overflow and passively overtop the weir and flow south towards Grant Avenue. The overflow should be constructed one foot above the existing invert. The new manhole or reconfigured manhole must allow a CCTV camera to be inserted. This will probably require a 72-inch diameter manhole to be used.

Manhole Reconfiguration for Neimann/Railroad/Dutton Sewers Project (Project 3) – Similar to the manhole reconfiguration for the Southwest Area Sewers Project, existing sewer SP-2206, a 350 foot segment of 6-inch pipe on Hemenway Street that currently conveys flows from Neimann Street towards Anderson Avenue, will no longer be used to convey average flows in the buildout scenario since 100 percent of the flows will be diverted east on Neimann Street. In order to ensure that flows from the Neimann Street sewers travel east as intended towards Railroad Street, it is recommended that MH-2192 be reconfigured (or a new manhole to be constructed just downstream). The future configuration of MH-2192 should resemble a weir, which will prohibit daily flows from the aforementioned sewers from flowing south on Hemenway, yet allow surcharged flows due to downstream blockage to passively overtop the weir and flow south towards Anderson Avenue. The overflow should be constructed one foot above the existing invert. The new manhole or reconfigured manhole must allow a CCTV camera to be inserted. This will probably require a 72-inch diameter manhole to be used. A profile of the Hemenway/Anderson/Railroad sewers is presented in Figure 5-12. This profile shows that with flows diverted from this sewer at Hemenway Street and Neimann Avenue, there is only minor surcharging.

5.1.2.5 Profiles of Interest

This subsection presents the various "profiles of interest" listed below, and shown in **Figures 5-17 through 5-23:**

P1: Grant Avenue 10-inch Sewer (Taylor Street to East Street)

P2: Grant Avenue 8-inch Sewer (Taylor Street to East Street)

P3: Hemenway/Anderson/Railroad Sewer

P4: Hemenway Street from Neimann Street to Grant Avenue

P5: Neimann/Railroad/Dutton Sewer

P6: Neimann Street Deep Sewer

P7: Neimann Street Shallow Sewer

Figure 5-17: Profile for P1

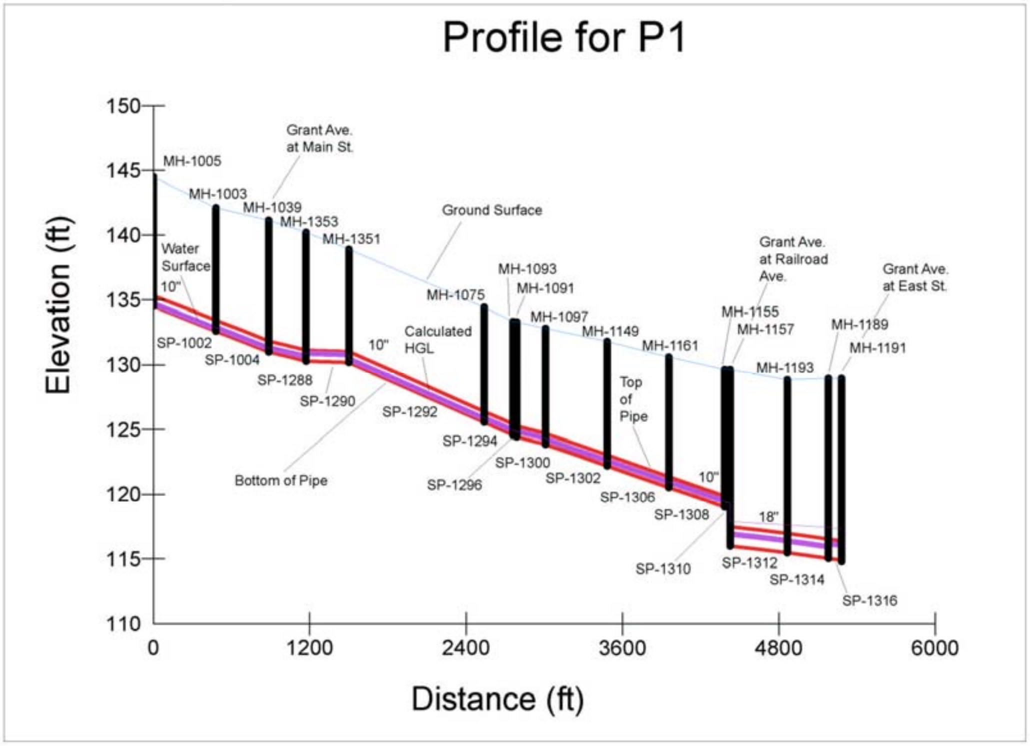


Figure 5-18: Profile for P2

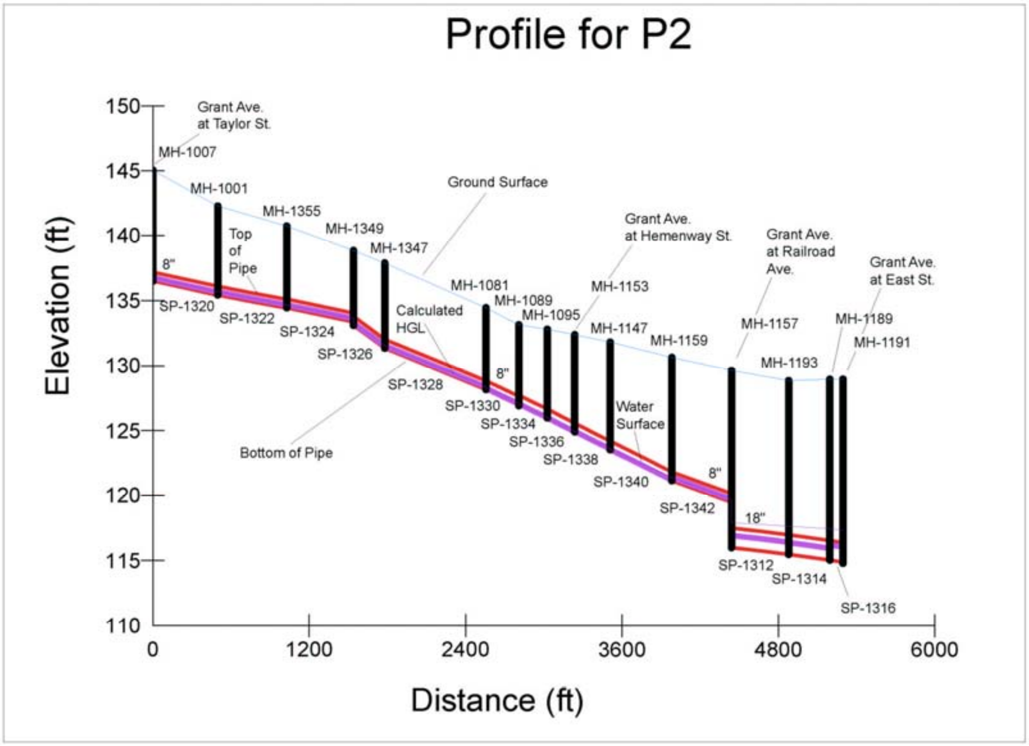


Figure 5-19: Profile for P3

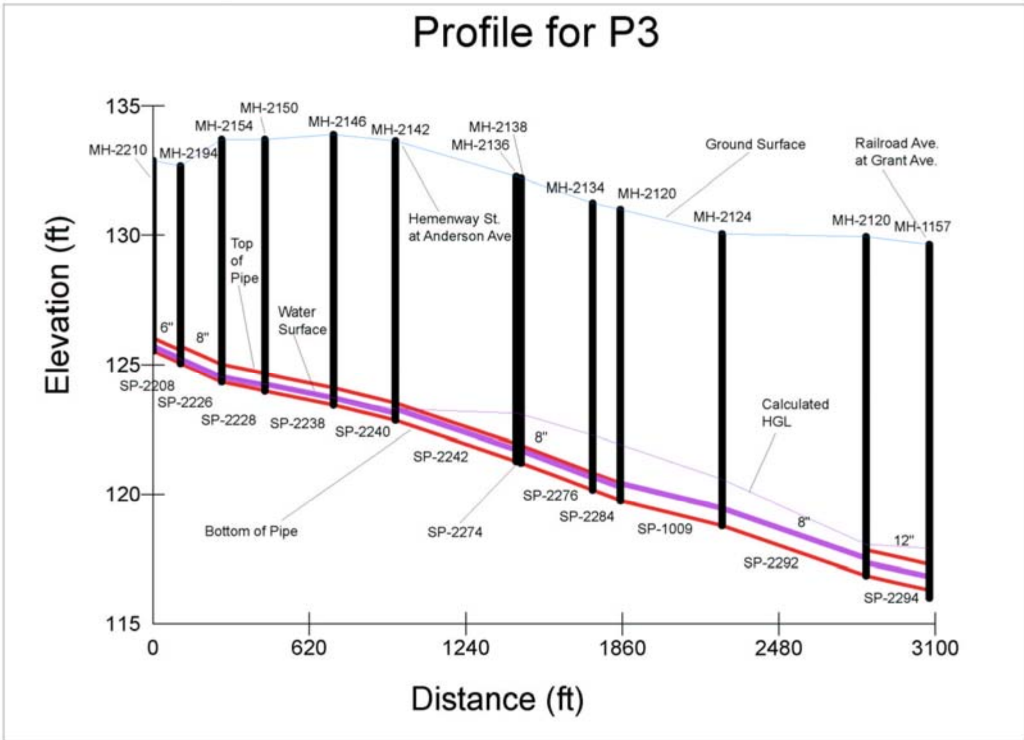


Figure 5-20: Profile for P4

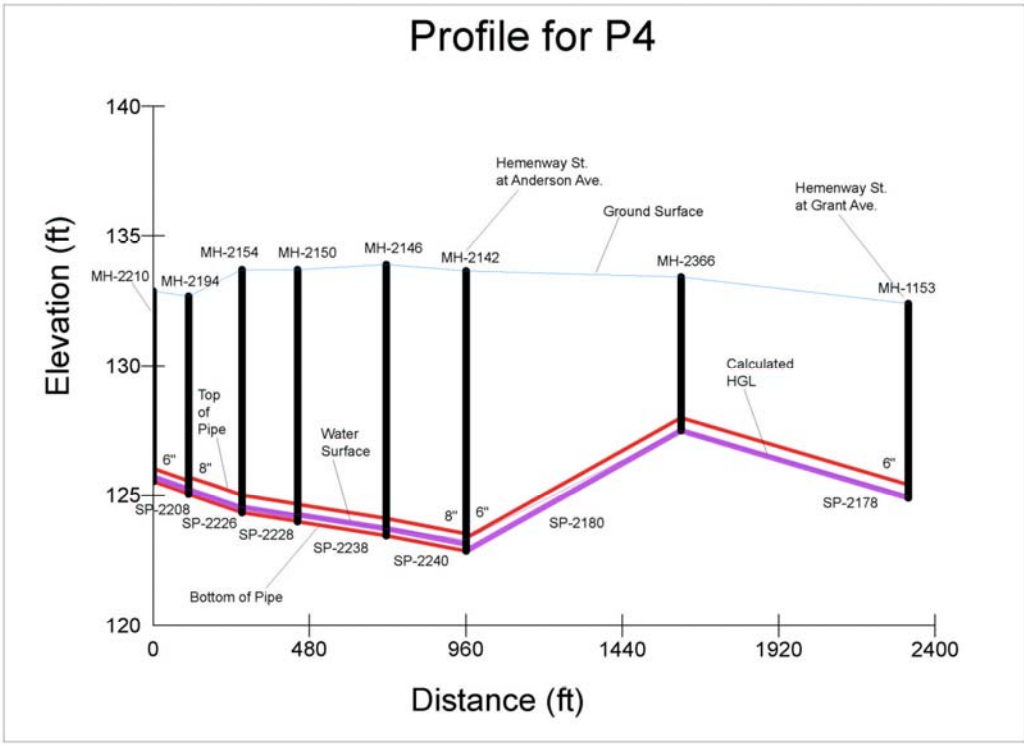


Figure 5-21: Profile for P5

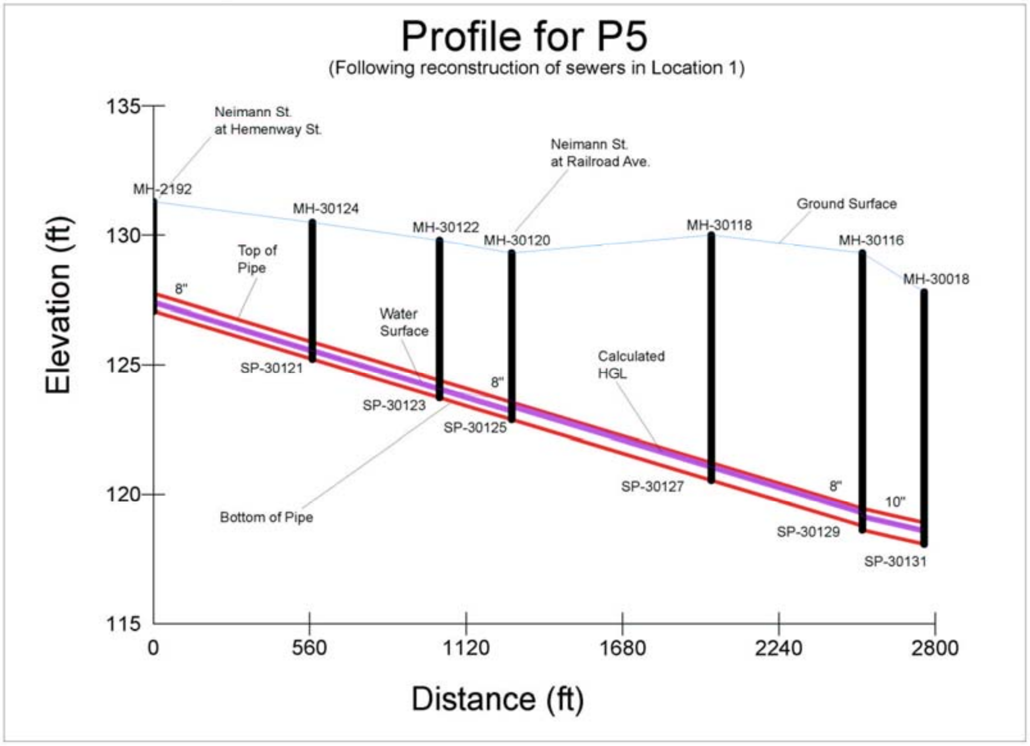


Figure 5-22: Profile for P6

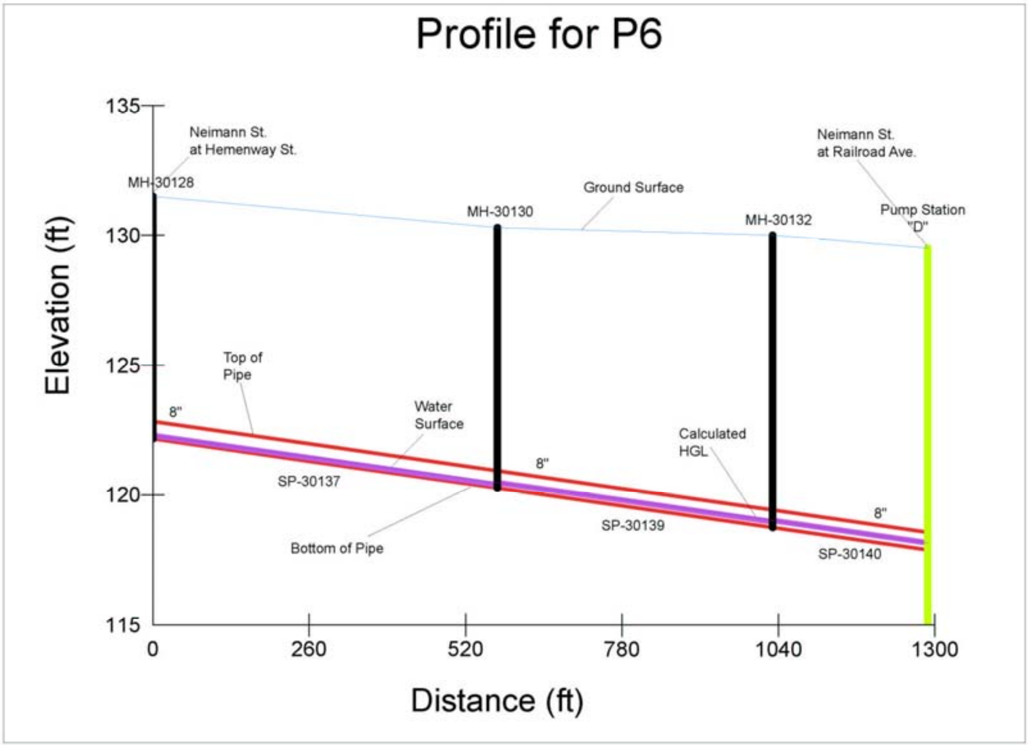
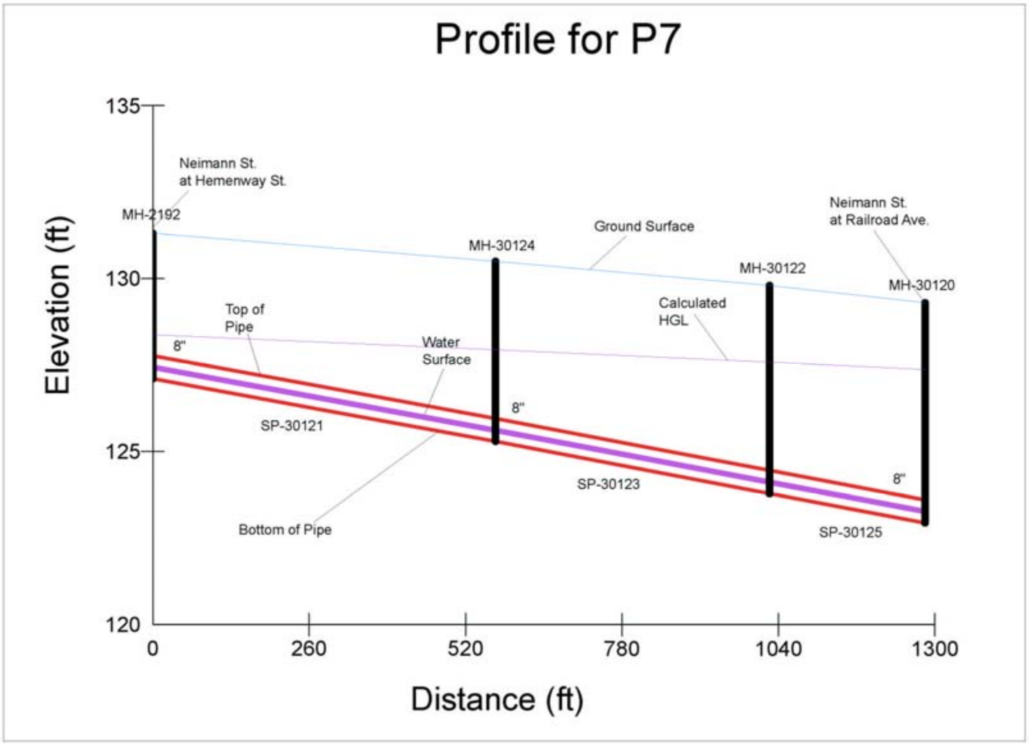


Figure 5-23: Profile for P7



5.2 Pump Station and Force Main Evaluations & Recommendations

This section presents the recommendations for the improvement and expansion of the City's pump stations, which have been based upon the modeling results for the City's future collection system. Due to the location of the City's wastewater treatment plant, all sewage in the City is pumped. Currently, all sewage is pumped by the East Street Pump Station. As the City grows, new pump stations will also pump to the wastewater treatment plant.

5.2.1 Pump Station Evaluation and Recommendations

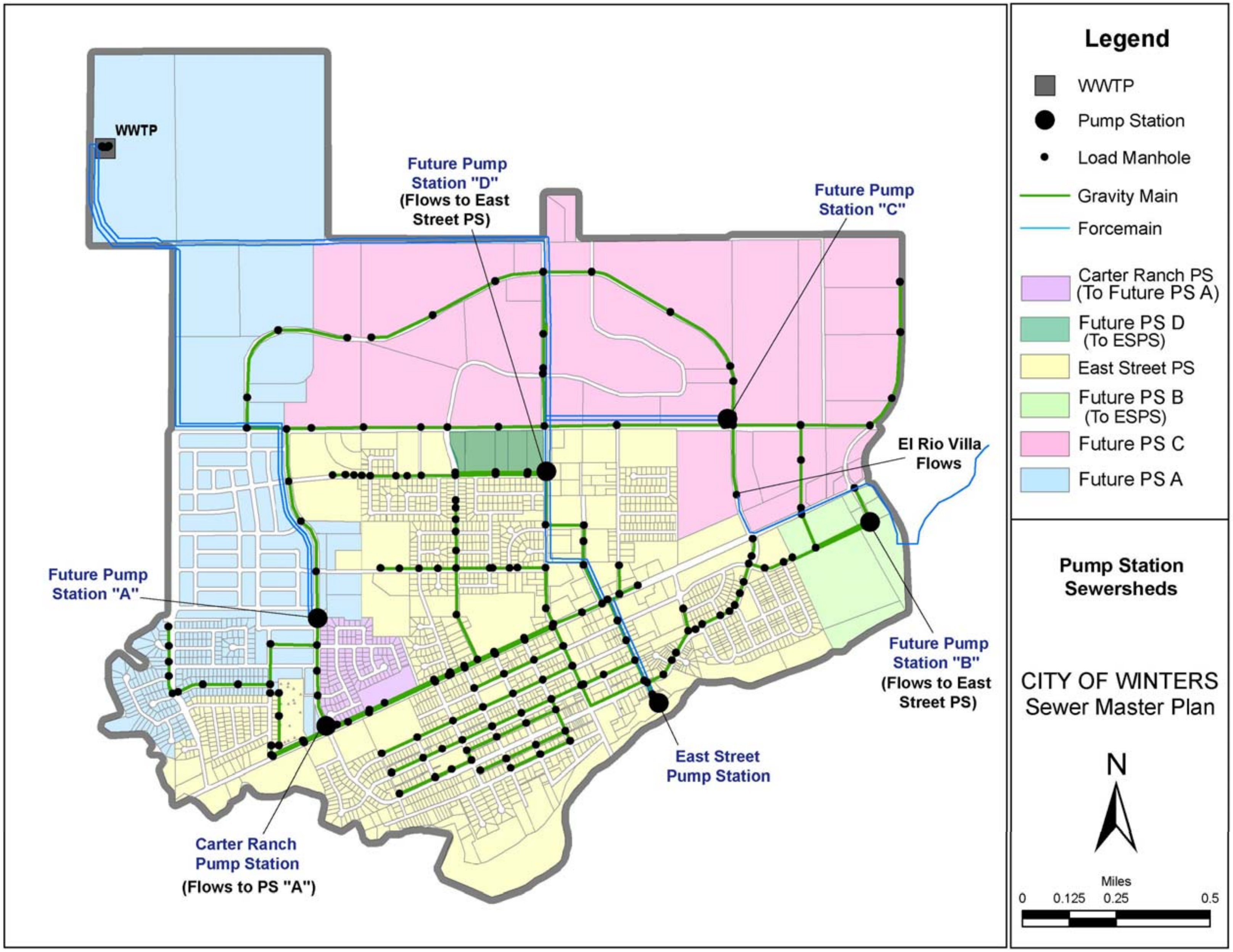
The City currently operates and maintains four pump stations: 1) Walnut Lane, 2) El Rio Villa, 3) Carter Ranch, and 4) East Street. For the purpose of this master plan, it was assumed that flows at the Walnut Lane and El Rio Villa Pump Stations are at buildout and, hence, the capacity of these pumps stations is adequate for future conditions.

Hydraulic analysis showed that at buildout, the City will need four more pump stations in order to convey all flows generated throughout the City to the existing wastewater treatment facility at the northwest corner of the urban limits boundary. A lift station, represented as the fourth future pump station in this master plan, is included in this number. The proposed locations of these four new pump stations (i.e. Future Pump Station "A", Future Pump Station "B", Future Pump Station "C", and Future Pump Station "D"), as well as individual pump station sewershed areas, are shown in Figure 5-10. The firm capacities for both existing and future pump stations are listed below:

1. East Street Pump Station = 3,160 gpm/4.55 mgd
2. Carter Ranch Pump Station = 186[7] gpm/0.27 mgd
3. Future Pump Station A = 1,240 gpm/1.79 mgd
4. Future Pump Station B = 310 gpm/0.45 mgd
5. Future Pump Station C = 2,322 gpm/3.35 mgd
6. Future Pump Station D = 106 gpm/0.15 mgd

[7] Includes passive overflow capacity. Nominal capacity at Carter Ranch PS is 125 gpm (0.18 gmd).

Figure 5-24: Pump Station Sewersheds



5.2.1.1 Recommendations for Existing Pump Stations

Carter Ranch Pump Station

The Carter Ranch Pump Station (PS) was designed to convey flows from the Carter Ranch subdivision to Grant Avenue until the land and infrastructure north of Carter Ranch (i.e. Winters Highlands and Callahan Estates) is developed and allows the sewage to flow north. The design capacity of the Carter Ranch PS is 125 gpm (0.18 mgd). Land use analysis, load allocation, and hydraulic modeling showed that at buildout, flows to the Carter Ranch PS will be approximately 170 gpm. Although the pump station was designed for a flow less than this, the design also included a passive overflow from the wet well to the gravity sewer on Main Street. For this reason, the Carter Ranch PS does not require any capacity improvements. The City is planning, however, to complete an upgrade of the Carter Ranch PS. The Carter Ranch lift station was originally designed and approved as a three-phase lift station. It was constructed, however, as a single phase lift station. The City plans to upgrade the pump station (Project 21) from its current electrical configuration to the three-phase configuration for which it was designed, including new pumps and a new electrical/instrumentation system.

East Street Pump Station

The East Street Pump Station (ESPS) is currently the main pump station for the City. All sewers currently drain to this pump station before being lifted and conveyed approximately 2.7 miles to the wastewater treatment facility via the 14-inch East Street Force Main (ESFM). This pump station has three pumps, two at 88 hp and one at 47 hp. Hence, the existing firm capacity of this pump station, with one of the 88 hp pumps being out of service, is approximately 1,600 gpm [8] (2.30 mgd) (See Appendix D). As part of this project, a focused analysis of two pump station alternatives was performed in order to determine the optimal configuration. These alternatives are summarized below:

> **Railroad PS Alternative:** This was the configuration proposed in the earlier Draft Sewer Collection System Master Plan (2004). The main component of the alternative was a proposed pump station on Railroad Street near Neimann Street. The Carter Ranch Pump Station would have collected sewage from Carter Ranch, Callahan Estates, and Ogando Hudson and pumped it north through a 3,640 foot long force main to a new gravity sewer in the Winters Highlands area, which would then flow east along Neimann Street to the proposed pump station. In order to solve problems caused by a reach of over-loaded sewers (similar to Locations 2, 3, and 4 on Figure 5-1), 3,510 feet of existing sewers along Neimann, Hemenway, Anderson, and Railroad were proposed to be upsized.

> **Future PS 'A' Alternative:** This is the proposed configuration. The main component of this alternative is the proposed pump station at the southwest corner of Callahan Estates (Future PS A). The existing Carter Ranch PS lifts sewage into the existing dry gravity sewer in Main Street, which then flows north to Future PS A. Future PS A will serve Callahan Estates, Winters Highlands, and the western parcels north of Moody Slough. This pump station pumps directly to the WWTP in a new force main. In order to reduce the flow to the over-loaded sewers in Hemenway, Anderson, and Railroad, a new gravity sewer will extend from Neimann and Hemenway to Railroad and across a soon-to-be-developed parcel to Dutton Street. A new sewer at Adams and Taylor (upstream of the trailer park) diverts flow north and east to Future PS A, reducing the amount of flow in Grant Avenue and onward to the ESPS.

The results of the analysis, presented to the City in July 2005, showed that flows to the ESPS were essentially the same for both alternatives: 3,110 and 3,160 gpm for the Railroad PS Alternative and Future PS A Alternative, respectively. Because both alternatives exceed the capacity of the ESPS, an expansion would be required at the ESPS in both alternatives. The only alternative to an expansion of the ESPS would be to implement the following two modifications to the Railroad PS Alternative:

[8] Assumes a Hazen-Williams coefficient of 120

- Route the future Gateway force main north to the proposed gravity sewer on Main Street north of Grant Ave., which flows north to the future pump station on Moody Slough Rd (Future PS C in this Master Plan). This would divert 308 gpm from the ESPS.
- Divert all the flow from the Grant Avenue sewers to the CRPS as they pass Main Street near the CRPS. This would divert 390 gpm from the ESPS. This would require a new sewer from Grant Avenue to the CRPS and quadruple the flow to the CRPS.

Ultimately, the Future PS 'A' Alternative was selected by the City. As such, the modifications shown above to avoid ESPS expansion have not been recommended, since the configuration of the selected alternative is poorly suited to accommodate the second modification.

Under buildout conditions, flow from the Carter Ranch and El Rio Villa Pump Stations will cease to enter the ESPS. However, even without the flow from Carter Ranch and El Rio Villa, the ESPS will still need to convey 3,160 gpm (4.55 mgd) at buildout during PWWF events. The existing pumps at the ESPS are not capable of delivering the necessary head to convey PWWF to the wastewater treatment facility. As a result, the pumps at the ESPS will need to be upgraded as part of the ESPS expansion.

As the flows to the ESPS and pressures within the ESFM increase, it will become critical to upgrade portions of the pump station instrumentation. In particular, the flow data and pressure data should be recorded and stored electronically and alarm systems for the pump station functions (e.g. high water, pump failure, etc.) should be upgraded. Collecting this data will allow pump station and force main performance evaluations to be completed, which will allow timing of larger projects (e.g., a parallel force main) to be determined.

5.2.1.2 Recommended Future Pump Stations

Future Pump Station A – Future Pump Station A is located at the southwest corner of the proposed Callahan Estates development. The Carter Ranch PS lifts sewage into the existing dry gravity sewer in Main Street, which flows north to Future Pump Station A. Future PS A will also serve Callahan Estates, Winters Highland, and the western parcels north of Moody Slough Road. A new sewer at Adams and Taylor (upstream of the trailer park) will divert flow north and east to Future PS A, which reduces the amount of flow in Grant Avenue and onward to the East Street Pump Station.

Future Pump Station B – Future Pump Station B, referred to as the "Gateway Area PS", is located south of Grant Avenue near the eastern edge of the City's urban limits, and serves parcels south of Grant Avenue and east of the City's existing development. Flows from this pump station are pumped towards the existing gravity sewers on East Baker Street, where they flow by gravity towards the East Street Pump Station.

Future Pump Station C – Future Pump Station C is located near the intersection of East Main Street and Moody Slough Road. Future PS C will receive flows from El Rio Villa (following the rerouting of El Rio Villa flows in Project 13) and from the majority of the parcels north of Moody Slough Road.

Future Pump (Lift) Station D – Future Pump Station D consists of a lift station on Neimann Street that lifts sewage collected by a deeper sewer parallel to the Neimann portion of the Neimann/Railroad/Dutton sewers (Project 3). This pump station is required since the Neimann sewer is not deep enough to serve the parcels north of Neimann Street. If these parcels do not develop until after Pump Station C is constructed, Pump Station D can be deleted and instead the flows can go to Pump Station C. Sewage is lifted to the proposed gravity sewer on Neimann that will ultimately convey the sewage down Dutton Street and on towards the East Street Pump Station.

All recommended pump station improvement projects are summarized in **Table 5-4** and shown on **Figure 5-28**.

5.2.2 Force Main Evaluations and Recommendations

Force mains were modeled using H_2OMap Water Suite 6.0, using the design criteria described in Chapter 4 for the buildout scenario.

East Street Pump Station Force Main Analysis

The existing ESFM is a 14-inch asbestos cement pipe with a length of 14,986 feet. Based on an analysis of the force main under buildout PWWF conditions, assuming a C-value of 100, the operating pressure in the force main was found for two scenarios:

For the first scenario, which assumes that the force mains from Future Pump Station C will tie directly into the existing ESFM, the operating pressure in the ESFM reaches approximately 278 psi at the ESPS, well beyond the limits of its design parameters with respect to surge pressure and depth of cover (based on Figure 14F in AWWA C401). This analysis confirms the necessity of a new 18-inch force main parallel to the existing ESFM from the junction of the force mains from Future Pump Station C to the wastewater treatment facility.

For the second scenario, which assumes that the existing ESFM conveys only the flows from the ESPS, the operating pressure in the ESFM reaches approximately 150 psi at the pump station, which approaches the limits of its design parameters with respect to surge pressure and depth of cover (based on Figure 14F in AWWA C401). It is recommended that a performance evaluation be completed, in order to determine the actual friction factors for the existing force main, immediately after a SCADA system has been installed at the pump station (SCADA installation will enable collection of the data necessary for the evaluation).

The existing force main is 25 years old and a detailed Force Main Rupture Plan should be completed in order to reduce or eliminate a sewage spill into Putah Creek if a rupture were to occur. A rupture in the ESFM is an event that may occur for a variety of reasons, the most common of which is being accidentally broken by a contractor excavating in the vicinity of the force main. An old clarifier adjacent to the East Street Pump Station will contain flows for a short time (approximately one hour at high flows), but should not be the only component of a Force Main Rupture Plan.

For inspection, maintenance, and overflow prevention purposes, it is recommended that a 14-inch parallel force main be constructed between the ESPS and the junction with the proposed Future Pump Station C force mains. The existing force main is 25 years old and this parallel force main would allow the existing force main to be taken out of service during dry weather for condition assessment and maintenance. In the absence of additional friction data, the recommendation for a parallel force main also provides an additional layer of safety during PWWF conditions. For capacity purposes, in addition to inspection, maintenance, and overflow prevention purposes, it is recommended that a parallel 18-inch force main be constructed between the junction with the proposed Future Pump Station C force mains and the wastewater treatment facility. The installation timing for both parallel force main segments will be dependent on the results of the evaluation for the existing force main and the rate of future development projects in the City.

Project 18, presented in **Table 5-4**, includes the recommendation for a parallel 14-inch force main from the ESPS to the junction of two 12-inch pipes from Future Pump Station C. Project 19 presents the recommendation for the second segment of the parallel ESPS force main, an 18-inch force main between the junction with the 12-inch Future Pump Station C force mains and the wastewater treatment facility. A schematic of force main alignments and anticipated velocities[9] during PDWF and PWWF are shown in **Figures 5-25 and 5-26**, respectively.

[9] Based on preliminary modeling of force mains. Velocities are presented as planning-level figures, and should be reevaluated prior to design.

Force Main for Future Pump Station A

Future Pump Station A will pump directly to the wastewater treatment facility through new dual 8-inch force mains, which combine just south of the facility and become a single 12-inch force main.

Force mains from Future Pump Station A will consist of dual 8-inch diameter ductile iron pipes (DIP) for use during wet weather flows. The 8-inch pipes will combine to form one 12-inch force main at County Road 88/County Road 32A and lead to the wastewater treatment plant. One 8-inch force main will be used during dry weather flows. The valving configuration for these force mains is presented in **Appendix E**. Future Pump Station A will be built during the development of Callahan Estates.

Force Main for Future Pump Station C

Sewage entering the pump station is pumped west through new dual 12-inch force mains directly to the parallel East Street force main on Railroad Avenue. From there, sewage in a new 18-inch parallel East Street force main continues directly towards the wastewater treatment facility.

Future Pump Station C will consist of dual 12-inch diameter ductile iron pipes for wet weather flows. The two 12-inch pipes will connect with a future 14-inch force main to form a new 18-inch pipe which will deliver sewage to the treatment plant.

The force mains will be built in phases based around the construction of developments. Force main construction is shown as a series of schematics in **Figure 5-27**. Phase 1 consists of the existing system (14-inch force main from the ESPS). Phase 2 includes the construction of Callahan Estates with Future Pump Station A and associated dual 8-inch and 12-inch force mains. Phase 3 (buildout conditions) includes the construction of Future Pump Station C with dual 12” force mains connecting to the newly constructed parallel 14-inch force main from the ESPS. The three force mains will join to form one 18-inch pipe. Valves at junction points will be necessary to manipulate flows. **Appendix E** presents the recommended valving configuration for PWWF conditions as well as a variety of operational and maintenance scenarios during dry weather flows.

Table 5-4: Proposed Pump Station Expansion Projects

Project No.	DESCRIPTION	PROPOSED DIAMETER (in)	LENGTH (ft)	PROPOSED PUMP STATION FIRM CAPACITY [a]
2	**Pump (Lift) Station on Railroad Avenue**			
	Future Pump Station D	---	---	*106 gpm/0.15 mgd*
6	**Pump Station for Southwest Area**			
	Future Pump Station A	---	---	*1,240 gpm/1.79 mgd*
	Divert CRPS flows form Grant Ave. to Pump Station A	---	---	---
	Dual Force Mains from Pump Station A to County Road 88/County Road 32A	8	13,800	---
	Single Force Main from County Road 88/County Road 32A to Treatment Plant	12	2,300	
7	**Pump Station for Gateway Area**			
	Future Pump Station B	---	---	*310 gpm/0.45 mgd*
8	**Pump Station B Force Main**			
	Gateway Area Pump Station Force Main	8	360	---
10	**Pump Station for the Northeastern Area**			
	Future Pump Station C	---	---	*2,322gpm/3.35 mgd*
	Dual Force Mains to the Parallel East Street Pump Station Force Main	14	5,200	---
17	**East Street Pump Station Expansion**			
	East Street Pump Station Expansion [b]	---	---	*3,160 gpm/4.55 mgd*
	East Street Pump Station Instrumentation	---	---	---
18	**Parallel East St. PS Force Main 1 (from East St. PS to Railroad/Moody Slough)**			
	Parallel Force Main Segment #1	14	4,800	---
19	**Parallel East St. PS Force Main 2 (from Railroad/Moody Slough to Treatment Plant)**			
	Parallel Force Main Segment #2	18	10,100	---
21	**Carter Ranch Pump Station Upgrade**			
	Upgrade pumps and instrumentation at existing PS	---	---	*125 gpm/0.18mgd*

[a.] Firm capacity is the capacity of the pump station with the largest pump not operating.
[b.] The existing firm capacity of the East Street Pump Station is 1,650 gpm.

Figure 5-25: Peak Dry Weather Flows in Force Mains at Buildout

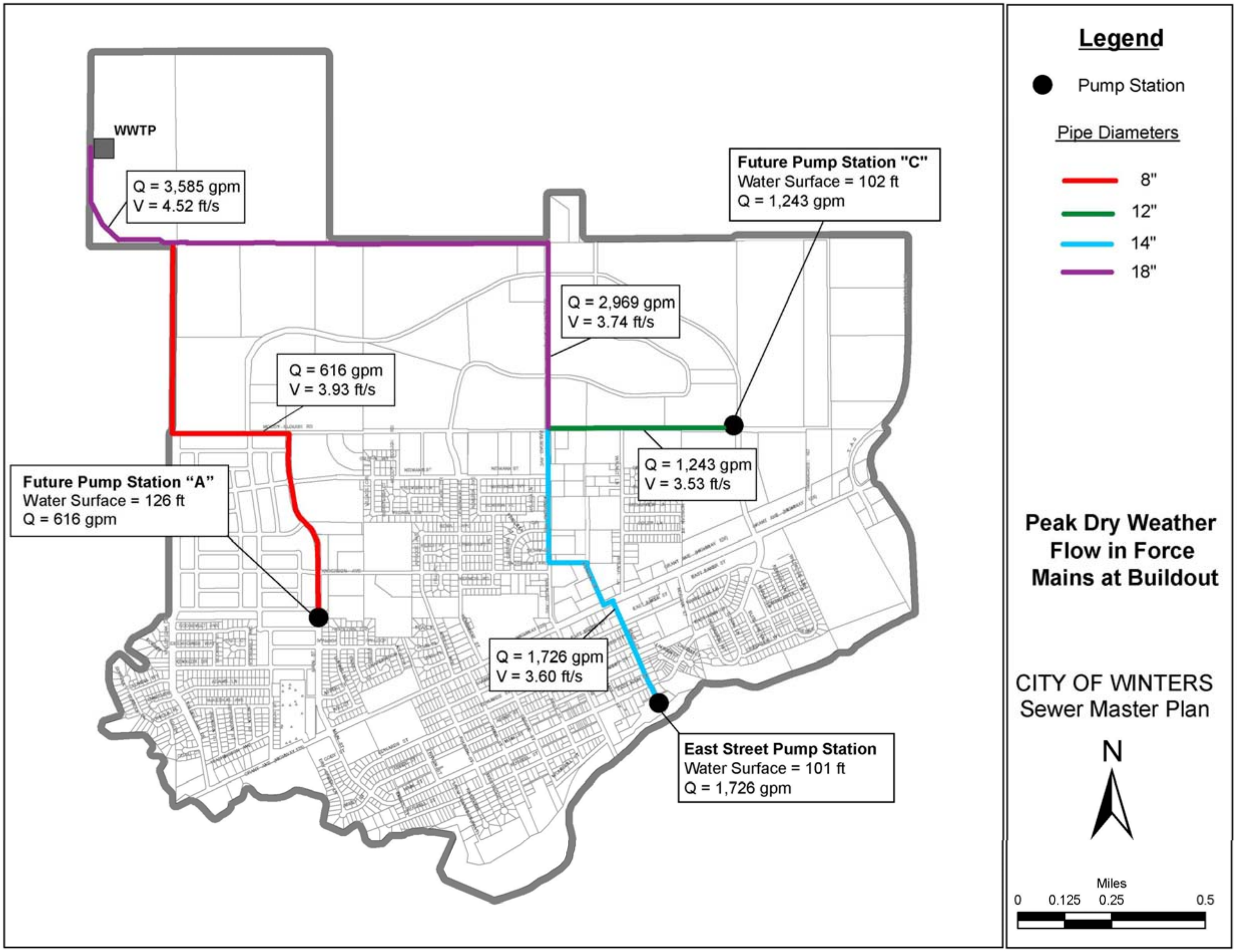


Figure 5-26: Peak Wet Weather Flows in Force Mains at Buildout

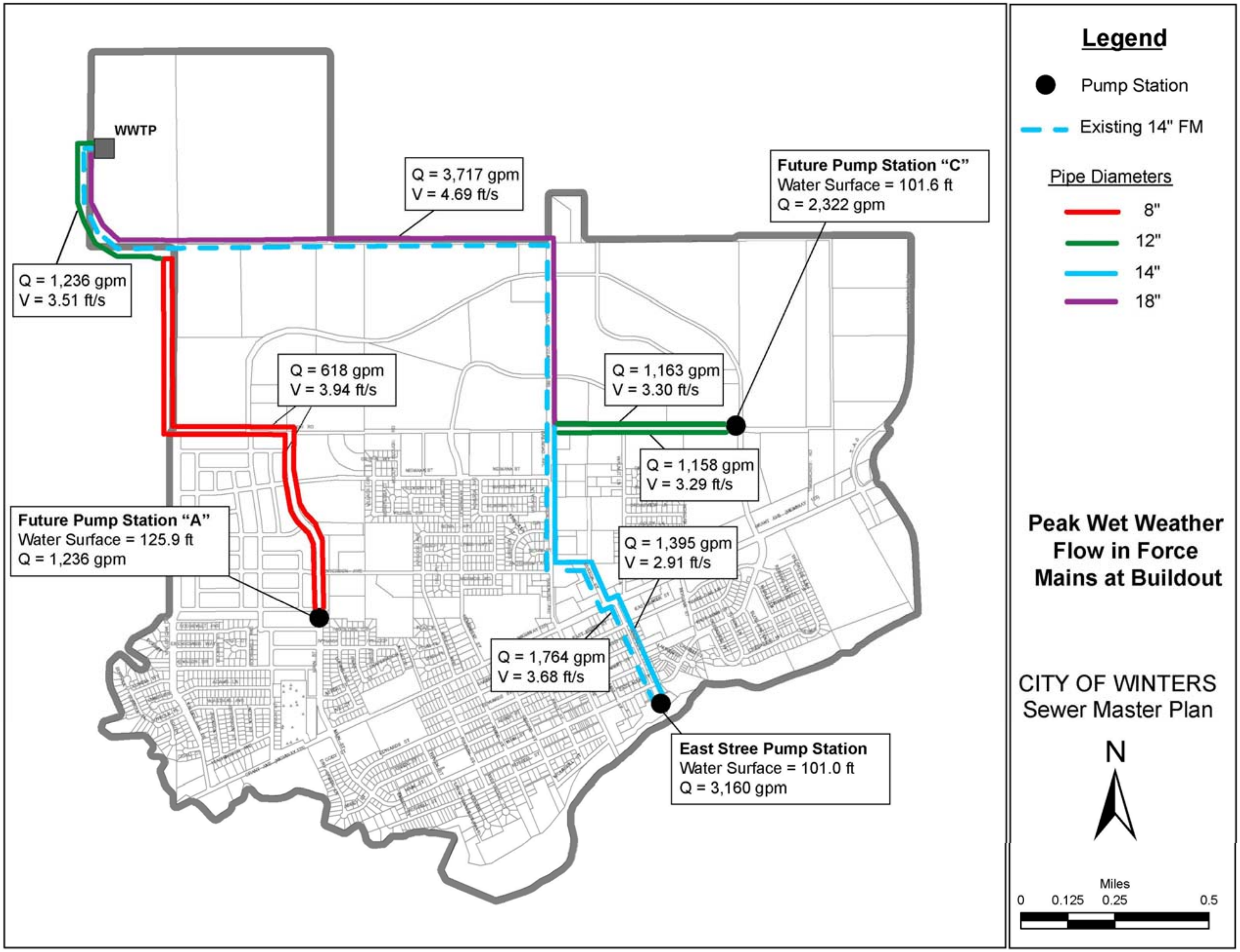
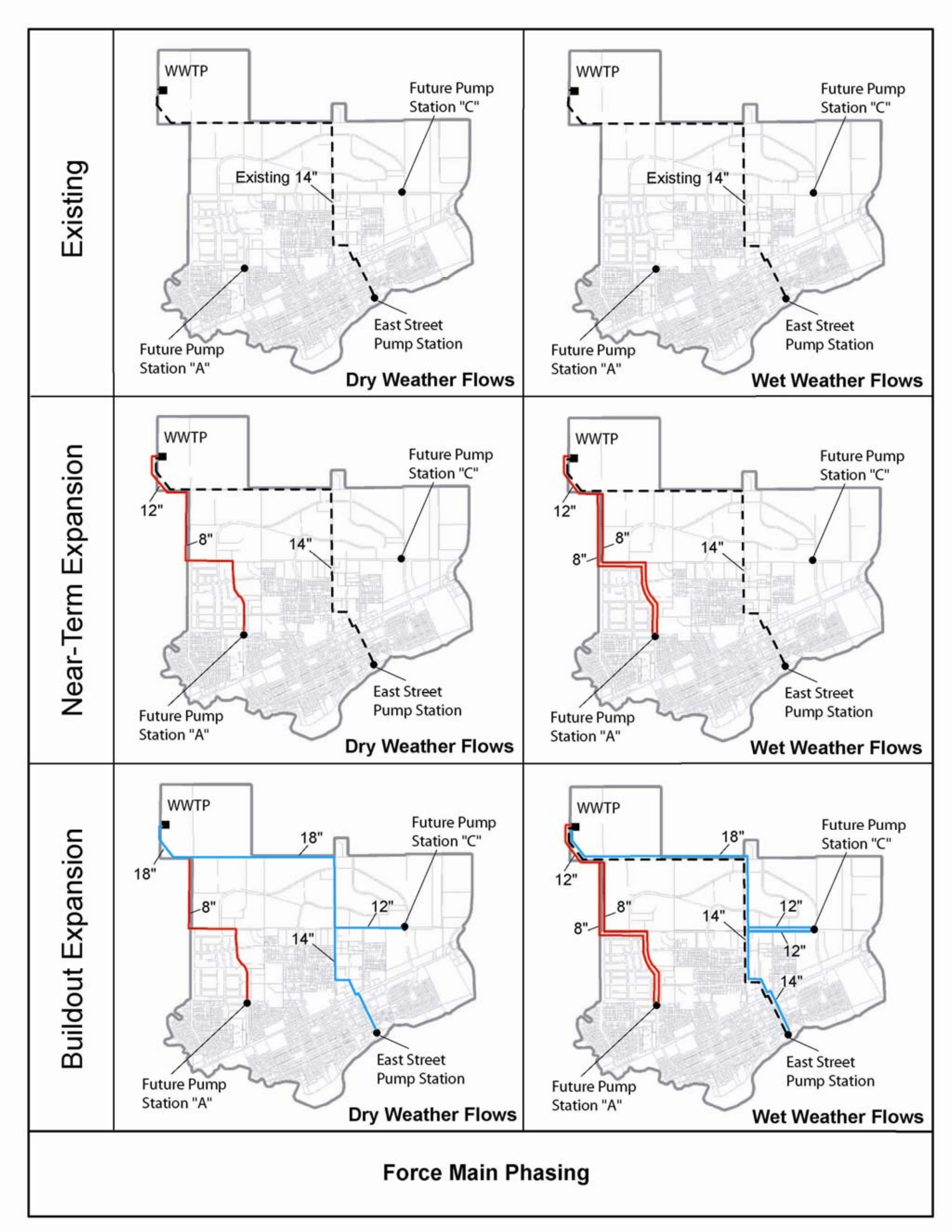


Figure 5-27: Phasing of Force Mains to Buildout



5.3 Future Collection System Expansions

The proposed future collection system expansion layout presented in **Figure 5-28** was developed based on inputs from the City, the Drainage Master Plans, the proposed Winters Highlands and Callahan Estates developments, and hydraulic modeling of the buildout peak wet weather scenario. In all, there are twenty sewer and pump station projects listed in Table 5-6 and shown in Figure 5-28.

Table 5-5: Future Sewer Expansion Projects

Project No.	Description	Proposed Diameter (in)	Length (ft)
3	**Neimann/Railroad/Dutton Sewers**		
	Neimann Street at Hemenway to Dutton Street	8	2,540
	Neimann Street west of Railroad Avenue	10	220
4	**Parallel Deep Sewer on Neimann Street (to Pump Station D)**		
	Neimann Street (Hemenway St. to Railroad Ave.)	8	1,290
5	**Southwest Area Sewers**		
	Taylor St. at Adams Ln. to Ivy Loop at Main St.	8	1,240
9	**Gateway Area Sewers**		
	South of Grant Ave; west of Pump Station B	8	1,860
11	**Northeastern Area Sewers**		
	Northmost Sewer on County Road 90	8	710
	County Road 90 to Moody Slough Road	10	2,440
	Moody Slough Road to North Main Street	15	1,090
	North Main Street to Future Pump Station C	18	110
12	**Timbercrest Road Sewers**		
	Timbercrest Road to Moody Slough Road	8	1,200
13	**North Main Street Sewers**		
	North Main Street south of Moody Slough	8	980
	Reroute El Rio Villa Force Main	6	600

(Continued on next page)

Project No.	Description	Proposed Diameter (in)	Length (ft)
14	**Main Street Loop Sewers**		
	Main Street Loop & Railroad Avenue to intersection of Railroad Avenue and Main Street	8	4,200
	Main Street Loop east of Railroad Avenue	10	690
	Main Street Loop: east of SP-30067 to north of SP-30109	12	3,150
15	**Eastern Main Street Sewers**		
	Main Street Loop: west of SP-30053 to south of SP-30049	8	1,200
	Main Street Loop to Main Street at Neimann Street	10	1,730
	Main Street from Neimann Street to Anderson Avenue	12	1,390
	Main Street to Future Pump Station A	15	670
16	**Moody Slough Sewers**		
	Moody Slough Road: east of Main Street to west of SP-30037; Railroad Avenue to Moody Slough Road	8	3,410
	Moody Slough Road: SP-30037 to Walnut Lane	10	1,680
	Moody Slough Road to Future Pump Station C	12	1,670
20	**Relief Sewer from Railroad/East Abbey to Main Street**		
	Railroad Ave. and East Main Street	18	1,175

5.4 Summary of Proposed Sewer Projects

The proposed collection system expansions shown in **Figure 5-28** include one sewer improvement project listed in Table 5-2, eight pump station expansion projects listed in Table 5-4, and eleven sewer expansion projects listed in Table 5-5. An itemized listing of all pipe segments for the proposed expansion projects is presented in Table 5-6. **Figures 5-29 through 5-32** present the proposed collection system expansion in greater detail.

Table 5-6: Itemization of all Sewer Improvement and Expansion Projects

PIPE ID	DESCRIPTION	PROPOSED DIAMETER (in)	LENGTH (ft)	PROPOSED PUMP STATION FIRM CAPACITY
Project 1 – Dutton Street Sewer Upsize				
SP-30017	East Main St east of East St	10	610	---
SP-30019	East Main St east of SP-1286	10	340	---
Project 2 – Pump (Lift) Station on Railroad Avenue				
---	Future Pump Station D	---	---	106 gpm/0.15mgd
Project 3 – Neimann/Railroad/Dutton Sewers				
SP-30121	Neimann Street east of Hemenway Street	8	570	---
SP-30123	Neimann Street east of SP-30123	8	460	
SP-30125	Neimann Street west of Railroad Avenue	8	260	
SP-30127	Railroad Avenue south of Neimann Street	8	710	
SP-30129	West of Railroad Avenue	8	540	
SP-30131	Dutton Street south of SP-30129	10	220	
Project 4 – Parallel Deep Sewer on Neimann Street (to Pump Station D)				
SP-30137	Neimann Street east of Hemenway Street	8	570	---
SP-30139	Neimann Street east of SP-30137	8	460	
SP-30141	Neimann Street west of Railroad Avenue	8	260	
Project 5 – Southwest Area Sewers				
SP-30135	Taylor Street north of Adams Lane	8	570	---
SP-30133	Ivy Loop west of Main Street	8	670	
Project 6 – Pump Station for Southwest Area				
---	Future Pump Station A	---	---	1,240 gpm/1.79 mgd
----	Divert CRPS flows from Grant Avenue to PS A	---	---	---
---	Dual Force Mains from Pump Station A to County Road 88/County Road 32A	8	13,800	---
---	Single Force Main from County Road 88/County Road 32A to Treatment Plan	12	2,300	
Project 7 – Pump Station for Gateway Area				
---	Future Pump Station B	---	---	310 gpm/0.45 mgd

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PIPE ID	DESCRIPTION	PROPOSED DIAMETER (in)	LENGTH (ft)	PROPOSED PUMP STATION FIRM CAPACITY
Project 8 – Pump Station B Force Main				
SP-30015	Gateway Area Pump Station Force Main	8	360	---
Project 9 – Gateway Area Sewers				
SP-30001	South of Grant Avenue & Timbercrest Road	8	510	---
SP-30003	South of Grant Avenue & County Road 90	8	510	
SP-30007	West of Pump Station B	8	840	
Project 10 – Pump Station for the Northeastern Area				
---	Future Pump Station C	---	---	2,322 gpm/3.35 mgd
	Dual Force Mains to the Parallel East Street Pump Station Force Main	12	5,200	---
Project 11 – Northeastern Area Sewers				
SP-30087	Northmost Sewer on County Road 90	8	710	---
SP-30089	County Road 90 south of SP-30087	10	950	
SP-30091	County Road 90 south of SP-30089	10	500	
SP-30093	Moody Slough Road west of County Road 90	10	990	
SP-30085	Moody Slough Road west of SP-30093	15	950	
SP-30077	North Main Street north of Moody Slough Rd.	15	140	
SP-30109	North Main Street to Future Pump Station C	18	110	
Project 12 – Timbercrest Road Sewers				
SP-30105	Timbercrest Road north of Grant Avenue	8	680	---
SP-30083	Timbercrest Road north of SP-30105	8	520	
Project 13 – North Main Street Sewers				
SP-30081	North Main Street south of Moody Slough	8	980	---
---	Reroute El Rio Villa Force Main	6	600	
Project 14 – Main Street Loop Sewers				
SP-30053	Westernmost Sewer on Loop for Project 14	8	1,100	---
SP-30055	Main Street Loop east of SP-30053	8	1,020	
SP-30057	Main Street Loop west of Railroad Avenue	8	720	
SP-30059	Railroad Avenue south of Main Street Loop	8	880	
SP-30061	Railroad Avenue south of SP-30059	8	480	
SP-30067	Main Street Loop east of Railroad Avenue	10	690	
SP-30069	Main Street Loop east of SP-30067	12	1,260	
SP-30071	Main Street Loop southeast of SP-30069	12	1,190	
SP-30099	Main Street Loop south of SP-30071	12	220	
SP-30101	Main Street Loop south of SP-30099	12	480	

(Continued on next page)

PIPE ID	DESCRIPTION	PROPOSED DIAMETER (in)	LENGTH (ft)	PROPOSED PUMP STATION FIRM CAPACITY
Project 15 – Eastern Main Street Sewers				
SP-30049	Main Street Loop west of SP-30053	8	510	---
SP-30051	Main Street Loop south of SP-30049	8	690	
SP-30027	Main Street Loop north of Moody Slough Road	10	430	
SP-30239	Moody Slough Road east of Main Street Loop	10	590	
SP-30299	Main Street south of Moody Slough	10	710	
SP-30301	Main Street south of Neimann Street	12	620	
SP-30303	Main Street north of Anderson Avenue	12	770	
SP-30305	Main Street to Future Pump Station A	15	670	
Project 16 – Moody Slough Sewers				
SP-30097	Moody Slough Road east of SP-30029	8	750	
SP-30031	Moody Slough Road east of SP-30097	8	820	
SP-30033	Moody Slough Road east of SP-30031	8	380	
SP-30035	Moody Slough Road east of SP-30033	8	730	
SP-30037	Moody Slough Rd. west of Railroad Avenue	10	650	
SP-30063	Railroad Avenue north of Moody Slough Rd.	8	740	
SP-30079	Moody Slough Road east of Railroad Ave.	10	1,030	
SP-30103	Moody Slough Road east of SP-30079	12	1,530	
SP-30295	Moody Slough Road to Future Pump Station C	12	140	
Project 17 – East Street Pump Station Expansion				
---	East Street Pump Station Expansion	---	---	*3,160 gpm/4.55 mgd*
	East Street Pump Station Instrumentation	---	---	---
Project 18 – Parallel East St. PS Force Main 1 (from East St. PS to Railroad/Moody Slough)				
---	Parallel Force Main Segment #1	14	4,800	---
Project 19 – Parallel East St. PS Force Main 2 (from Railroad/Moody Slough to Treatment Plant)				
---	Parallel Force Main Segment #2	18	10,100	---
Project 20 – Relief Sewer from Railroad/East Abbey to Main Street				
SP-30119	Railroad Ave. and East Main Street	18	1,175	---
Project 21 – Carter Ranch Pump Station Upgrade				
---	Upgrade pumps and instrumentation at existing PS	---	---	*125 gpm/0.18mgd*

Figure 5-28: Proposed Improvements and Expansions for Future Collection System

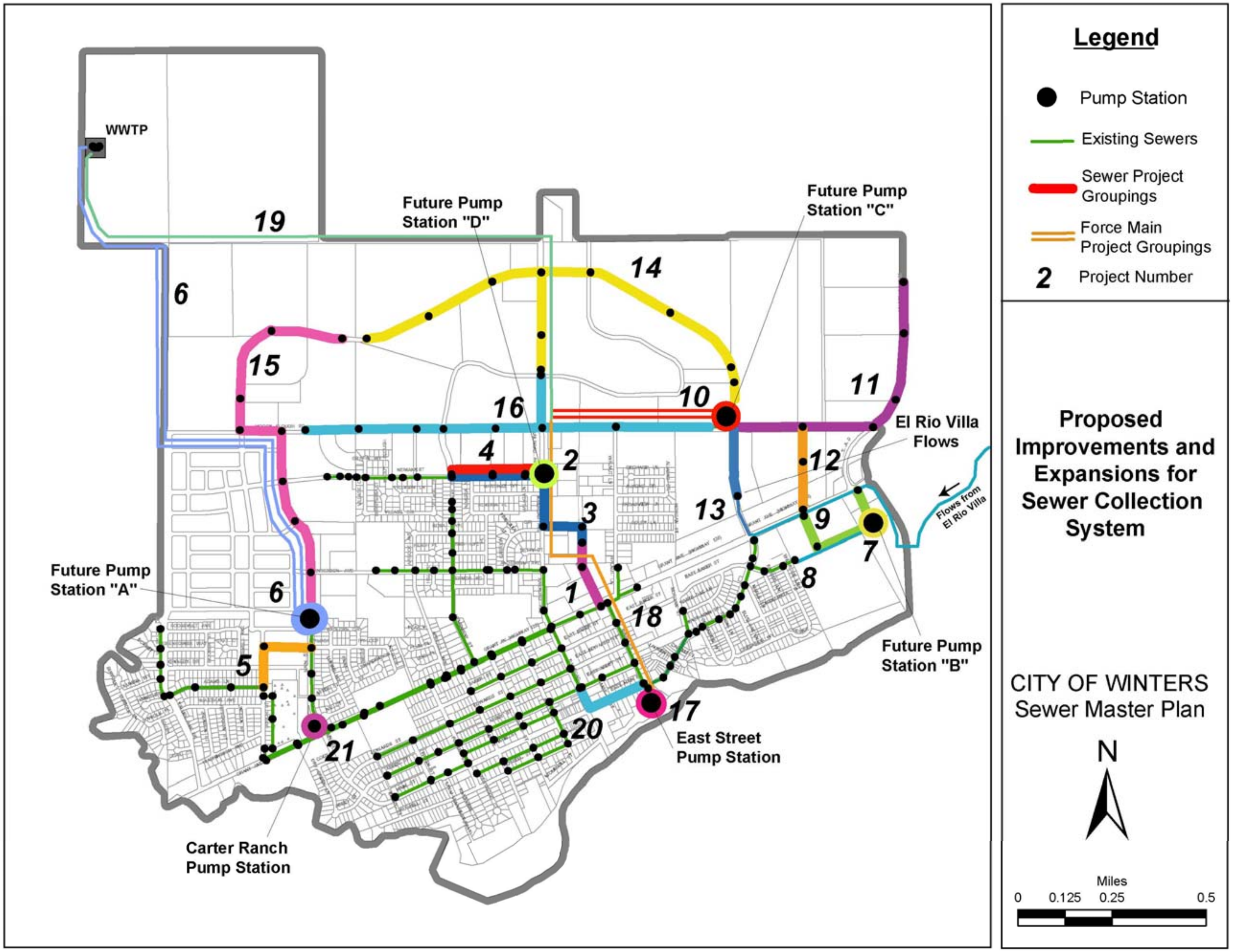


Figure 5-29: Projects 2, 3, 4, 5, 6, and 21

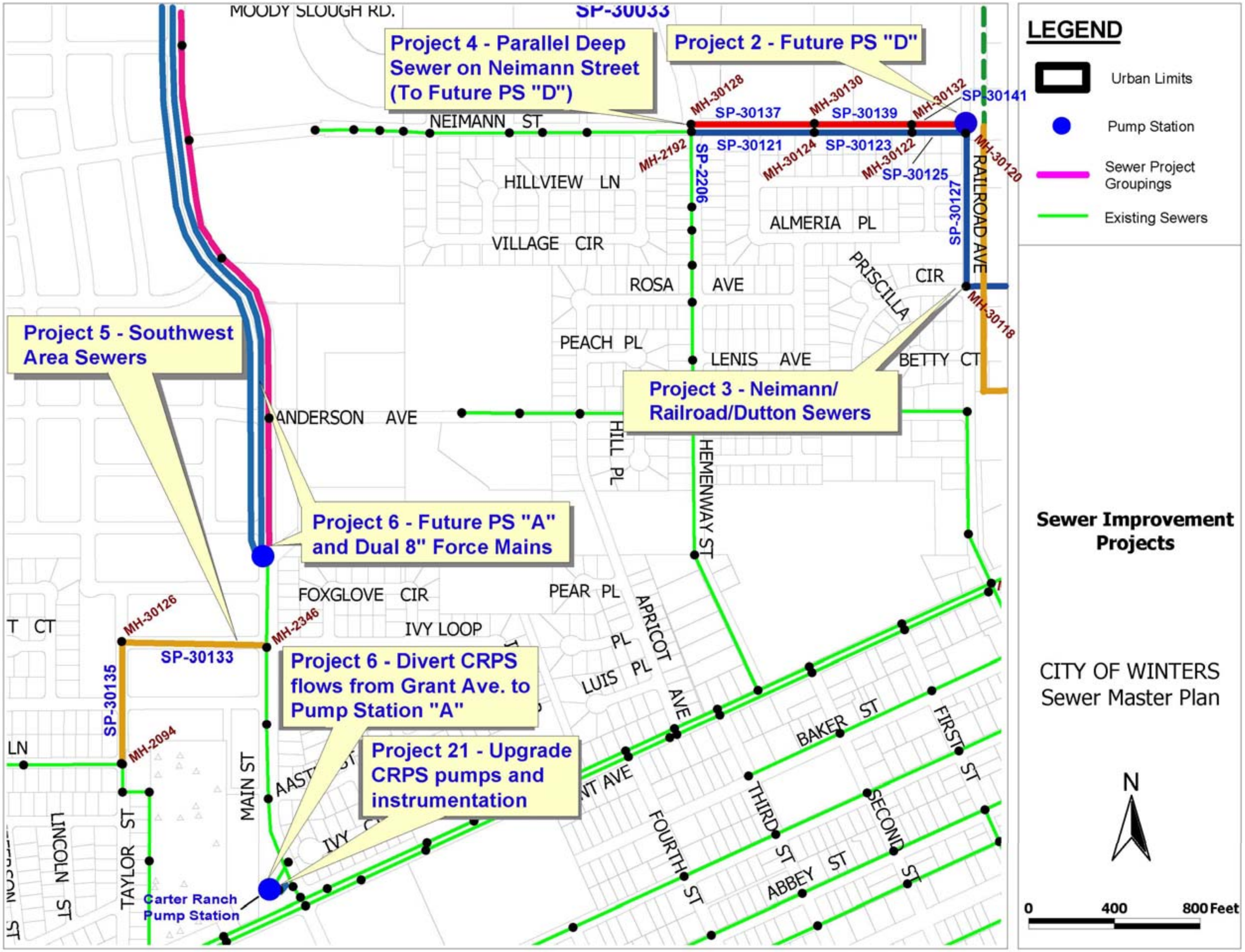


Figure 5-30: Projects 7, 8, 9, 10, 11, 12, and 13

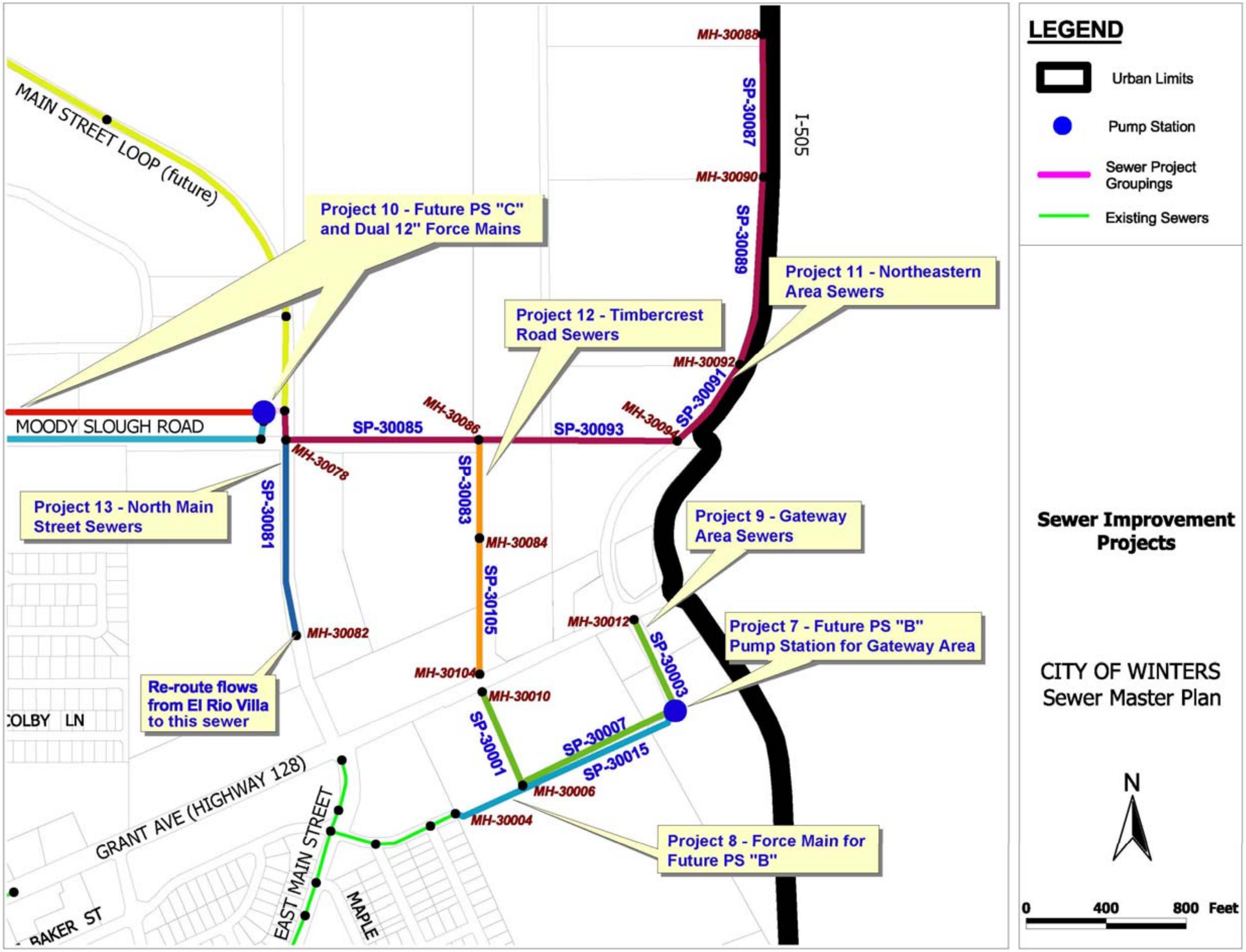


Figure 5-31: Projects 1, 3, 17, 18, and 20

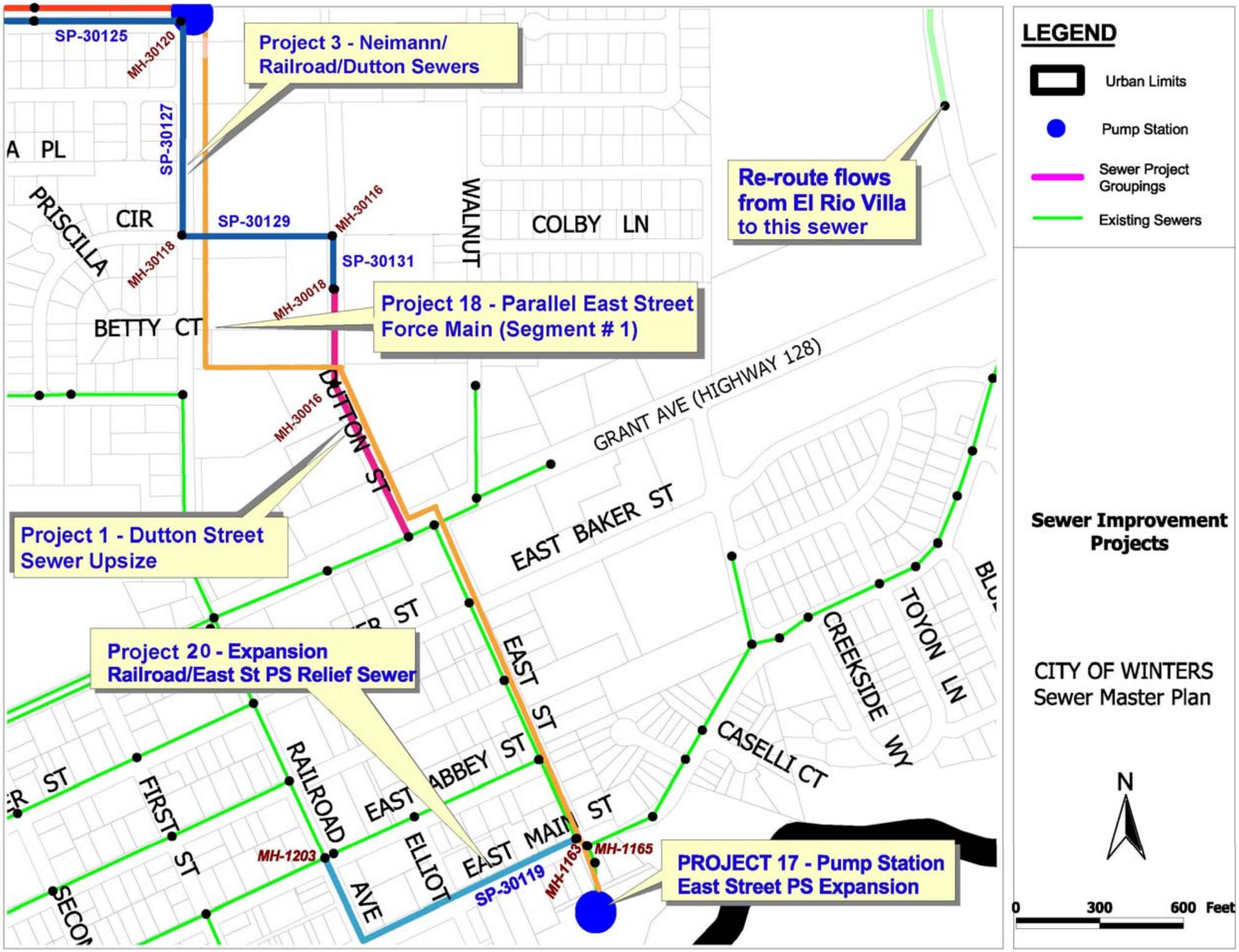
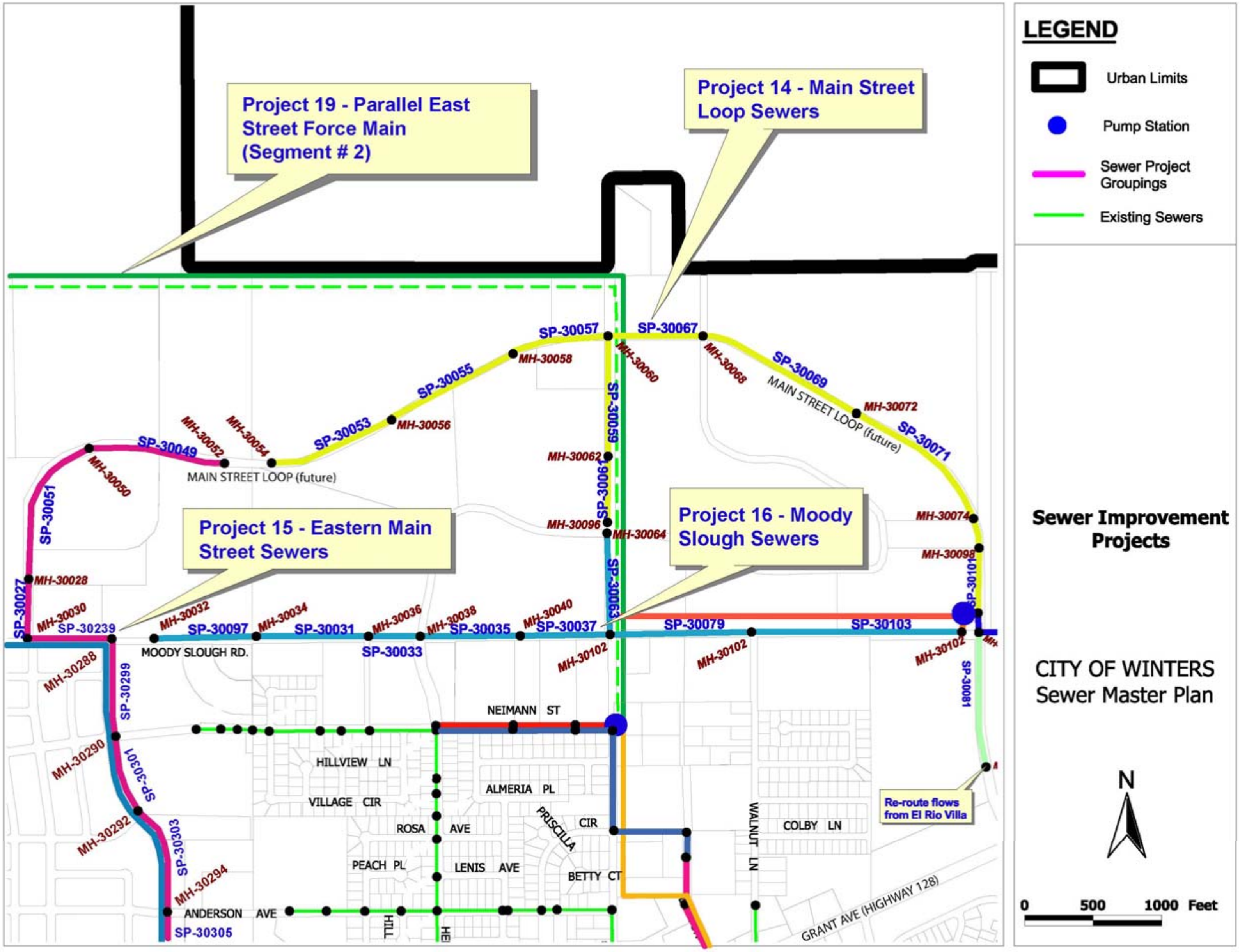


Figure 5-32: Projects 14, 15, 16, and 19



CHAPTER 6 CAPITAL IMPROVEMENT COSTS

Chapter Synopsis: This chapter presents the cost estimation criteria and estimated project cost for the recommended capacity improvement and expansion projects presented in Chapter 5. Detailed cost breakdowns for each project are documented in the project cost spreadsheet in Appendix A.

6.1 Cost Estimation Criteria

The following cost estimation criteria were used to develop typical planning level capital cost estimates for the identified sanitary sewer and pump station improvement projects.

6.1.1 Sanitary Sewer and Pump Station Costs

Sanitary sewer installation costs vary according to several factors including pipe materials, complexity of construction, traffic control, and street repair. The cost used in this Master Plan for installation of sewer pipes includes mobilization, traffic control, trenching, dewatering, pipe installation and lateral connections, manholes, and pavement replacement. This construction cost excludes contingency and is based on sewer installation costs used by the City in estimating project costs for the capital improvement plan (CIP).

Pump station costs were estimated based on cost curve data compiled by Robert Sanks and presented in Figure 29-3 of *Pumping Station Design* by Sanks. The Sanks cost curve, considered the "standard of the industry", was developed using historical construction costs of submersible wastewater pumping stations.

6.1.2 Construction Contingency and Project Implementation Multiplier

A construction contingency and project implementation multiplier of 43 percent was applied to each potential improvement project estimated installation cost.[10] The contingency is used to cover:

- Potential construction issues unforeseen at the planning level
- Administration costs
- Environmental assessments and permits
- Planning and engineering design
- Construction administration and management
- Legal fees

6.1.3 Coordination With Drainage, Water, and Road Improvement Projects

It is assumed that the construction schedule for expansion projects for new development areas will be coordinated with projects recommended by the City's Drainage Master Plan. Hence, increased costs for trenchless crossings of the future storm drainage system were not considered in estimating project costs. In addition to drainage improvement projects, where applicable, all recommended projects should be coordinated with projects recommended by the City's Water Master Plan and roadway rehabilitation projects.

6.2 Capacity Improvement & Expansion Projects

One sewer capacity improvement project, eight pump station expansion projects, and eleven sewer expansion projects were identified in Chapter 5 to correct existing wet weather conveyance deficiencies and serve the future buildout of the City. These projects and their associated costs are listed in Table 6-1 and shown in **Figures 5-29 through 5-32**. The implementation schedule for expansion projects will be dependent on development timing in the City.

[10] The City uses an overhead factor of 1.43 in estimating costs for CIP projects. The 1.43 overhead factor is based on historical experience where, on an average, construction costs for CIP projects are approximately 70 percent of the total project costs. Hence, for budgeting purposes, it is assumed that the overhead factor is 1.43 (i.e. 1.00/0.70 = 1.43)

The total length for these projects is approximately 0.2 miles of upsizing existing sewers, 6.9 miles of force main, and 6.2 miles of future gravity sewers. The associated total estimated capital cost for all projects is $17.2 million. Detailed cost estimates are included in **Appendix A**.

Table 6-1: Estimated Capital Cost for Sewer Conveyance Improvement and Expansion Projects

PROJECT NO.	DESCRIPTION	FIRM CAPACITY [a] (gpm)	LENGTH (ft)	ESTIMATED CAPITAL COST [b]
Existing Capacity Deficiency Projects				
1	Dutton Street Sewer Upsize	---	950	$201,000
		Subtotal	***950***	***$201,000***
Proposed Pump Station Expansion Projects				
2	Pump (Lift) Station on Railroad Avenue	106	---	$465,000
6	Future Pump Station A for Southwest Area	1,240	---	$1,859,000
	Dual Force Mains from Future Pump Station A	---	16,100	$2,089,000
7	Future Pump Station B for Gateway Area	310	---	$930,000
8	Future Pump Station B Force Main	---	360	$37,000
10	Future Pump Station C for Northeastern Area	2,170	---	$2,832,000
	Dual Force Mains to Parallel E. Street PS Force Mains	---	5,200	$804,000
17	East Street Pump Station Expansion	3,160	---	$1,430,000
	East Street Pump Station Instrumentation Updates	---	---	$69,000
18	Parallel E. St. PS Force Main Segment #1	---	4,800	$1,030,000
19	Parallel E. St. PS Force Main Segment #2	---	10,100	$2,423,000
21	Carter Ranch PS Upgrade	125	---	$189,000
		Subtotal	***29,860***	***$14,156,000***
Future Collection System Expansion Projects				
3	Neimann/Railroad/Dutton Sewers	---	2,760	$341,000
4	Parallel Sewers on Neimann Street (to Pump Station D)	---	1,290	$160,000
5	Southwest Area Sewers	---	1,240	$154,000
9	Gateway Area Sewers	---	1,860	$230,000
11	Northeastern Area Sewers	---	4,350	$829,000
12	Timbercrest Road Sewers	---	1,200	$149,000
13	North Main Street Sewers	---	1,580	$196,000
14	Main Street Loop Sewers	---	8,040	$1,274,000
15	Eastern Main Street Sewers	---	6,280	$1,059,000
16	Moody Slough Sewers	---	9,330	$1,056,000
20	Railroad/East Abbey to Main Street Relief Sewer	---	1,175	$398,000
		Subtotal	***39,105***	***$5,846,000***
22	Master Plan Implementation and Management [c]			***$1,011,000***
		TOTAL	**69,915**	**$21,214,000**

[a] Firm capacity is the capacity of the pump station with the largest pump not operating.
[b] Rounded up to the nearest $1,000.
[c] Assume cost to be 5% of the total estimated capital cost for projects 1 through 21. A small portion of the cost includes additional engineering analysis for certain recommended projects.

6.3 Additional Recommendations

Following are the recommendations that were developed related to the other objectives of this Master Plan.

6.3.1 H_2OMap Sewer System Hydraulic Model

The H_2OMap Sewer model developed for this Master Plan provides the City with a valuable tool for analyzing the capacity of the sewer system at a planning level. The model can also be used to test the impact of development proposals. The model should be updated periodically to reflect changes in the sewer system (new sewer construction and any development) and revised flow information.

6.3.2 Flow Monitoring Data

It is recommended that a system-wide temporary flow monitoring program be conducted to collect data and refine the hydraulic model by:

- refine the dry weather sewage generation factors for various land use categories;
- evaluate groundwater infiltration (GWI) and rainfall-dependent inflow/infiltration (RDI/I) rates;
- develop diurnal variation curves for different land use categories;
- develop the shape of the wet weather response hydrograph for different areas of the City;
- calibrate the model under fully dynamic conditions; and
- refine the system capacity analysis and recommended capital improvement projects

The existing ADWF factors and peaking factors used to develop the design flows (i.e. PWWF) are considered to result in relatively conservative design flows. Modifying sewer loading and I/I loading based on evaluation of flow monitoring data could therefore reduce the number or extent of the recommended sewer capacity improvement projects.

The flow generation factor for single family parcels is the most critical parameter to measure during flow monitoring programs. Based on a quick review of the Winters' sewer system, it appears that the manhole at Taylor Street and Grant Avenue would be a good candidate for dry weather flow monitoring as it appears to have a very uniform sewer shed of single family dwelling units. Monitoring the amount of sewage flowing to the Carter Ranch Pump Station would be a good measurement of sewage being generated by newer single family dwelling units. During the wet weather months, measuring the amount of flow at the manhole on Grant Avenue between Railroad Avenue and Dutton Street would allow the systems response to rain storms to be observed. The best calibration data would be the flow data entering the ESPS and if the ESPS Instrumentation Upgrade Project has been completed, the data from the new SCADA system can be used. Additional dry weather and wet weather sites may be necessary.

Confirming the sewage generation flowrates and connection location(s) of the larger point loads (the various schools and Mariani) would improve the accuracy of the model and may reduce the extent or eliminate some of the projects. Monitoring flows along Edwards Street is recommended (See Section 5.1.2.4 for additional discussion).

The cost of a dry and wet weather flow monitoring program including dynamic modeling and refining the capital improvement projects would range between $60,000 and $90,000. If the instrumentation upgrade is performed before the flow monitoring is started, the cost of the flow monitoring program could be reduced.

6.3.3 East Street Pump Station and Force Main Evaluation

The East Street Pump Station (ESPS) and Force Main (ESFM) are critical components of the City's infrastructure. Currently, 100 percent of the City's sewage is pumped by the ESPS and conveyed by the

ESFM. The pump station and force main were constructed in 1979 and the end of the useful life of some mechanical components is approaching. Even though the City did upgrade some of the electrical components at the ESPS several years ago, a detailed evaluation of the ESPS and ESFM, including a condition assessment and hydraulic analysis, will allow proper planning for replacement or rehabilitation, as necessary.

As described in Section 5.2.1, the preliminary force main analysis showed that the surge pressure in the existing force is very near to the design parameters. The existing force main is Class 150 psi (according to the construction specifications). The flowrate which corresponds to a 140 psi operating pressure can be calculated after the roughness coefficient is measured. The best way to determine the roughness coefficient would be to measure the pressure at the beginning of the force main and near the end of the force main along with the flowrate. By installing a temporary pressure recorder near the end of the force main instead of using the free water surface elevation of the treatment plant to determine the headloss in the pipeline eliminates the need to estimate exit losses as the force main discharges into the treatment plant basins.

This evaluation should be performed after the ESPS Instrumentation Upgrade Project (Project 17) and prior to the ESPS expansion.

6.3.4 Force Main Rupture Plan(s)

As noted in Section 5.2.2, a detailed Force Main Rupture Plan is recommended for the East Street Force Main, as well as the force mains from other recommended future pump stations. The development of force main rupture plans will reduce or eliminate the impacts of a sewage spill if a rupture were to occur. Ruptures in force mains are events that may occur for a variety of reasons, the most common of which is being accidentally broken by a contractor excavating in the vicinity of the force main.

6.3.5 Sewer System Management Plan (SSMP)

Historically, Winters has relatively few sewer overflows. Sewer overflows can be caused by many factors including, root clogs, grease clogs, broken pipes, wet weather infiltration, pump station mechanical failure, vandalism, illegal disposal of wastes, and power failures. State regulators have recently adopted a statewide Waste Discharge Requirement (WDR) that will require all collection system agencies to prepare a Sewer System Management Plan. Because of the broad range of factors that cause overflows, the WDR is also broad and regulates aspects of capacity, management, operations, and maintenance, or CMOM for short. Winters should proactively meet the requirements of the SSMP.

6.3.6 Miscellaneous

- Uncover manholes that are paved over on Grant Avenue.
- Survey the invert elevations of SP-1290 on Grant Avenue. See Section 5.1.2.4 for more discussion.
- Reconfigure manholes MH-2192 on Neimann Street at Hemenway Street and MH-2194 on Taylor Street. See Section 5.1.2.4 for additional discussion.
- Implement a cleaning and televising inspection program.

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8. Creegan & D'Angelo, "Sewer Master Plan Update – Greyhawk Development," Draft, February 2001.

9. H_2OMAP Sewer Version 5.0 Users Guide, 2003.

10. Jepperson, R.W., Analysis of Flow in Pipe Networks. Ann Arbor Science Publishers Inc., Michigan.

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13. May, D.K., A.W. Peterson, and N. Rajaratnam, A Study of Manning's Roughness Coefficient for Commercial Concrete and Plastic Pipes. University of Alberta, T. Blench Hydraulics Laboratory Technical Report, 1986.

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15. Sank, Robert L., *Pump Station Design*, Butterworth-Heinemann, 1998.

16. Straub, L.G., C.E. Bowers, and M. Pilch, Resistance to Flow in Two Types of Concrete Pipe. Technical Paper No. 22, Series B, December, 1960. St. Anthony Falls Hydraulics Laboratory, University of Minnesota.

17. Wood Rodgers, "Moody Slough Subbasin Drainage Master Plan," Draft, June 2005.

18. Wood Rodgers, "Putah Creek, Dry Creek Subbasins Drainage Master Plan," Draft, July 2005.

19. Yolo County, Winters GIS Parcel Map, October 2003.

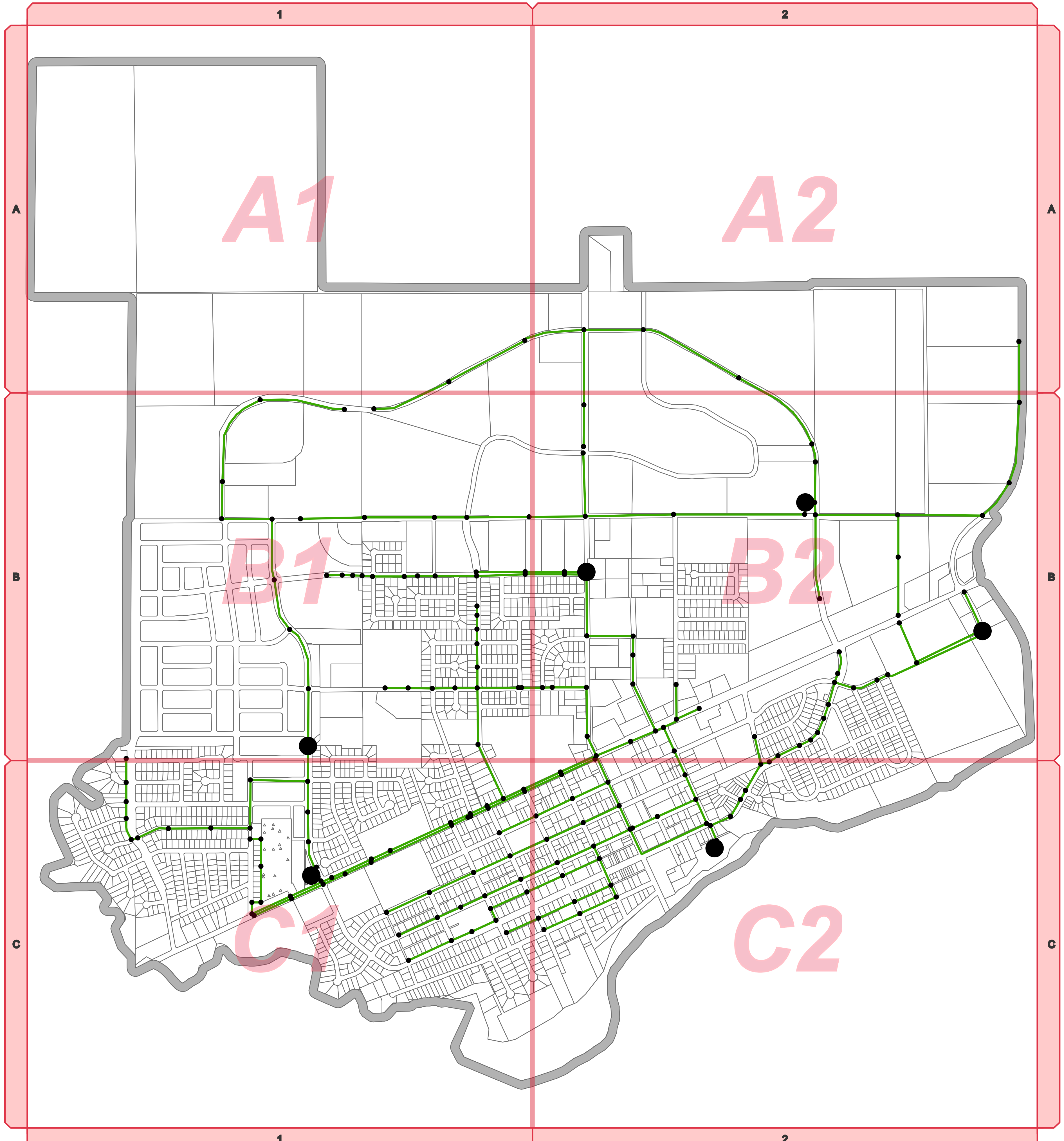
APPENDIX A

DETAILED CIP COST ESTIMATE INFORMATION

Project No.	Pipe ID	Street	Size	Existing Street?	Units	Unit Cost	Contingency Multiplier	Estimated Capital Cost
1	SP-30017	East Main Street east of East Street	10 in.	Yes	610 ft	148 $/LF	1.43	$ 128,700
	SP-30019	East Main Street east of SP-1286	10 in.	Yes	340 ft	148 $/LF	1.43	$ 71,700
1 Total					**950 ft**			**$ 201,000**
2	---	Future Pump Station D	106 gpm	---	1	$ 325,000	1.43	$ 464,300
2 Total					**1**			**$ 465,000**
3	SP- 30121	Neimann Street east of Hemenway Street	8 in.	Yes	570 ft	86 $/LF	1.43	$ 70,400
	SP-30123	Neimann Street east of SP-30123	8 in.	Yes	460 ft	86 $/LF	1.43	$ 56,800
	SP-30125	Neimann Street west of Railroad Avenue	8 in.	Yes	260 ft	86 $/LF	1.43	$ 32,100
	SP- 30127	Neimann Street east of Hemenway Street	8 in.	Yes	710 ft	86 $/LF	1.43	$ 87,700
	SP- 30129	Neimann Street east of SP-30137	8 in.	Yes	540 ft	86 $/LF	1.43	$ 66,700
	SP- 30131	Neimann Street west of Railroad Avenue	10 in.	Yes	220 ft	86 $/LF	1.43	$ 27,200
3 Total					**2,760 ft**			**$ 341,000**
4	SP-30137	Neimann Street east of Hemenway Street	8 in.	Yes	570 ft	86 $/LF	1.43	$ 70,400
	SP-30139	Neimann Street east of SP-30137	8 in.	Yes	460 ft	86 $/LF	1.43	$ 56,800
	SP-30141	Neimann Street west of Railroad Avenue	8 in.	Yes	260 ft	86 $/LF	1.43	$ 32,200
4 Total					**1,290 ft**			**$ 160,000**
5	SP-30135	Taylor Street north of Adams Lane	8 in.	Yes	570 ft	86 $/LF	1.43	$ 70,500
	SP-30133	Ivy Loop west of Main Street	8 in.	Yes	670 ft	86 $/LF	1.43	$ 82,800
5 Total					**1,240 ft**			**$ 154,000**
6	---	Future Pump Station A	1,240 gpm	---	1	$1,300,000	1.43	$ 1,859,000
	---	Dual Force Mains from Pump Station A to	8 in.	Yes	8,600 ft	95 $/LF	1.43	$ 1,165,900
		County Road 88/County Road 32A to	8 in.	No	5,600 ft	71 $/LF	1.43	$ 567,000
	---	Single Force Main from County Road 88/County Road 32A to Treatment Plant	12 in.	No	2,300 ft	108 $/LF	1.43	$ 355,300
6 Total					**16,500 ft**			**$ 3,948,000**
7	---	Future Pump Station B	310 gpm		1	$ 650,000	1.43	$ 929,500
7 Total					**1**			**$ 930,000**
8	SP-30015	Gateway Pump Station Forcemain	8 in.	No	360 ft	71 $/LF	1.43	$ 36,500
8 Total					**360 ft**			**$ 37,000**
9	SP-30001	South of Grant Avenue & Timbercrest Road	8 in.	No	510 ft	86 $/LF	1.43	$ 63,100
	SP-30003	South of Grant Avenue & County Road 90	8 in.	No	510 ft	86 $/LF	1.43	$ 63,100
	SP-30007	West of Pump Station B	8 in.	No	840 ft	86 $/LF	1.43	$ 103,800
9 Total					**1,860 ft**			**$ 230,000**
10	---	Future Pump Station C	2,170 gpm	---	1	$1,980,000	1.43	$ 2,831,400
	---	Dual Force Mains to the Parallel East Street Pump Station Force Main	12 in.	No	5,200 ft	108 $/LF	1.43	$ 803,100
10 Total					**5,200 ft**			**$ 3,635,000**
11	SP-30087	Northmost Sewer on County Road 90	8 in.	No	710 ft	86 $/LF	1.43	$ 87,800
	SP-30089	County Road 90 south of SP-30087	10 in.	No	950 ft	124 $/LF	1.43	$ 168,000
	SP-30091	County Road 90 south of SP-30089	10 in.	No	500 ft	124 $/LF	1.43	$ 88,400
	SP-30093	Moody Slough Road west of County Road 90	10 in.	No	990 ft	124 $/LF	1.43	$ 175,000
	SP-30085	Moody Slough Road west of SP-30093	15 in.	No	950 ft	179 $/LF	1.43	$ 242,900
	SP-30077	North Main Street north of Moody Slough Rd.	15 in.	No	140 ft	179 $/LF	1.43	$ 35,800
	SP-30109	North Main Street to Future Pump Station C	18 in.	No	110 ft	196 $/LF	1.43	$ 30,800
11 Total					**4,350 ft**			**$ 829,000**
12	SP-30105	Timbercrest Road north of Grant Avenue	8 in.	No	680 ft	86 $/LF	1.43	$ 84,100
	SP-30083	Timbercrest Road north of SP-30105	8 in.	No	520 ft	86 $/LF	1.43	$ 64,300
12 Total					**1,200 ft**			**$ 149,000**
13	SP-30081	North Main Street south of Moody Slough	8 in.	No	980 ft	86 $/LF	1.43	$ 121,100
	---	Re-route El Rio Villa Forcemain	6 in.	No	600 ft	86 $/LF	1.43	$ 74,200
13 Total					**1,580 ft**			**$ 196,000**
14	SP-30053	Westernmost Sewer on Loop for Project 15	8 in.	No	1,100 ft	86 $/LF	1.43	$ 136,000
	SP-30055	Main Street Loop east of SP-30053	8 in.	No	1,020 ft	86 $/LF	1.43	$ 126,100
	SP-30057	Main Street Loop west of Railroad Avenue	8 in.	No	720 ft	86 $/LF	1.43	$ 89,000
	SP-30059	Railroad Avenue south of Main Street Loop	8 in.	No	880 ft	86 $/LF	1.43	$ 108,800
	SP-30061	Railroad Avenue south of SP-30059	8 in.	No	480 ft	86 $/LF	1.43	$ 59,400
	SP-30067	Main Street Loop east of Railroad Avenue	10 in.	No	690 ft	124 $/LF	1.43	$ 122,000
	SP-30069	Main Street Loop east of SP-30067	12 in.	No	1,260 ft	140 $/LF	1.43	$ 253,000
	SP-30071	Main Street Loop southeast of SP-30069	12 in.	No	1,190 ft	140 $/LF	1.43	$ 239,000
	SP-30099	Main Street Loop south of SP-30071	12 in.	No	220 ft	140 $/LF	1.43	$ 44,200
	SP-30101	Main Street Loop south of SP-30099	12 in.	No	480 ft	140 $/LF	1.43	$ 96,400
14 Total					**8,040 ft**			**$ 1,274,000**
15	SP-30049	Main Street Loop west of SP-30053	8 in.	No	510 ft	86 $/LF	1.43	$ 63,100
	SP-30051	Main Street Loop south of SP-30049	8 in.	No	690 ft	86 $/LF	1.43	$ 85,300
	SP-30027	Main Street Loop north of Moody Slough Road	10 in.	No	430 ft	124 $/LF	1.43	$ 76,100
	SP-30059	Railroad Avenue south of Main Street Loop	8 in.	No	880 ft	86 $/LF	1.43	$ 108,800
	SP-30061	Railroad Avenue south of SP-30059	8 in.	No	480 ft	86 $/LF	1.43	$ 59,400
	SP-30239	Moody Slough Road east of Main Street Loop	10 in.	No	590 ft	124 $/LF	1.43	$ 104,300
	SP-30299	Main Street south of Moody Slough	10 in.	No	710 ft	124 $/LF	1.43	$ 125,500
	SP-30301	Main Street south of Neimann Avenue	12 in.	No	620 ft	140 $/LF	1.43	$ 124,500
	SP-30303	Main Street north of Anderson Avenue	12 in.	No	700 ft	140 $/LF	1.43	$ 140,600
	SP-30105	Main Street to Future Pump Station A	15 in.	No	670 ft	179 $/LF	1.43	$ 171,400
15 Total					**6,280 ft**			**$ 1,059,000**
16	SP-30097	Moody Slough Road east of SP-30029	8 in.	No	750 ft	86 $/LF	1.43	$ 92,700
	SP-30031	Moody Slough Road east of SP-30097	8 in.	No	820 ft	86 $/LF	1.43	$ 101,400
	SP-30033	Moody Slough Road east of SP-30031	8 in.	No	380 ft	86 $/LF	1.43	$ 47,000
	SP-30035	Moody Slough Road east of SP-30033	8 in.	No	730 ft	86 $/LF	1.43	$ 90,200
	SP-30037	Moody Slough Rd. west of Railroad Avenue	10 in.	No	650 ft	124 $/LF	1.43	$ 114,900
	SP-30063	Railroad Avenue north of Moody Slough Rd.	8 in.	No	740 ft	86 $/LF	1.43	$ 91,500
	SP-30079	Moody Slough Road east of Railroad Ave.	10 in.	No	1,030 ft	124 $/LF	1.43	$ 182,100
	SP-30103	Moody Slough Road east of SP-30079	12 in.	No	1,530 ft	140 $/LF	1.43	$ 307,200
	SP-30295	Moody SloughRoad to Future Pump Station C	12 in.	No	140 ft	140 $/LF	1.43	$ 28,200
16 Total					**6,770 ft**			**$ 1,056,000**
17	---	East Street Pump Station Expansion	3,160 gpm	---	1	$1,000,000	1.43	$ 1,430,000
	---	East Street Pump Station Instrumentation	0 gpm	---	1	$ 48,000	1.43	$ 68,700
17 Total					**2**			**$ 1,499,000**
18	---	Parallel East Street Forcemain Segment #1	14 in.	Yes	4,800 ft	150 $/LF	1.43	$ 1,029,600
18 Total					**4,800 ft**			**$ 1,030,000**
19	---	Parallel East Street Forcemain Segment #2	20 in.	Yes	2,400 ft	186 $/LF	1.43	$ 638,400
			20 in.	No	7,700 ft	162 $/LF	1.43	$ 1,783,800
19 Total					**10,100 ft**			**$ 2,423,000**
20	SP-300119	Railroad Avenue and East Main Street	18 in.	Yes	1,175 ft	236 $/LF	1.43	$ 397,300
20 Total					**1,175 ft**			**$ 398,000**
21	---	Carter Ranch PS Upgrade	125 gpm	---	1	$ 132,000	1.43	$ 188,800
21 Total					**1**			**$ 189,000**
		All Projects Subtotal	**---**	**---**	**74,459 ft**		**---**	**$ 20,203,000**
22	---	Master Plan Implementation and Management	---	---	---		---	$ 1,010,150
22 Total								**$ 1,011,000**
		GRAND TOTAL	**---**	**---**	**74,459 ft**		**---**	**$ 21,214,000**

APPENDIX B

GIS & H2OMAP SEWER FILES AND MISCELLANEOUS MODELING INFO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2
A
B
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A1
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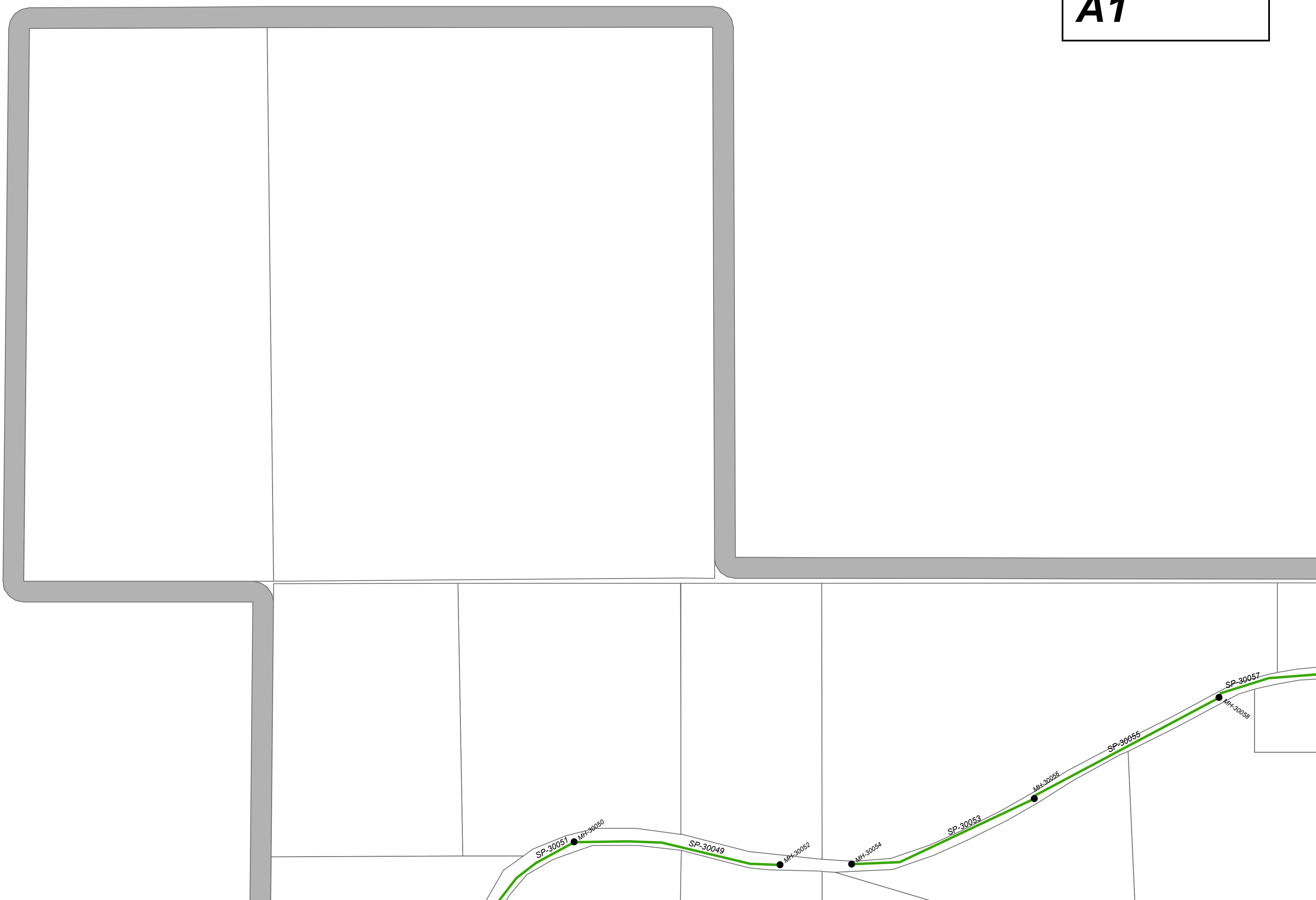
B1
B2
C1
C2

Pipe and Manhole ID Map

A1

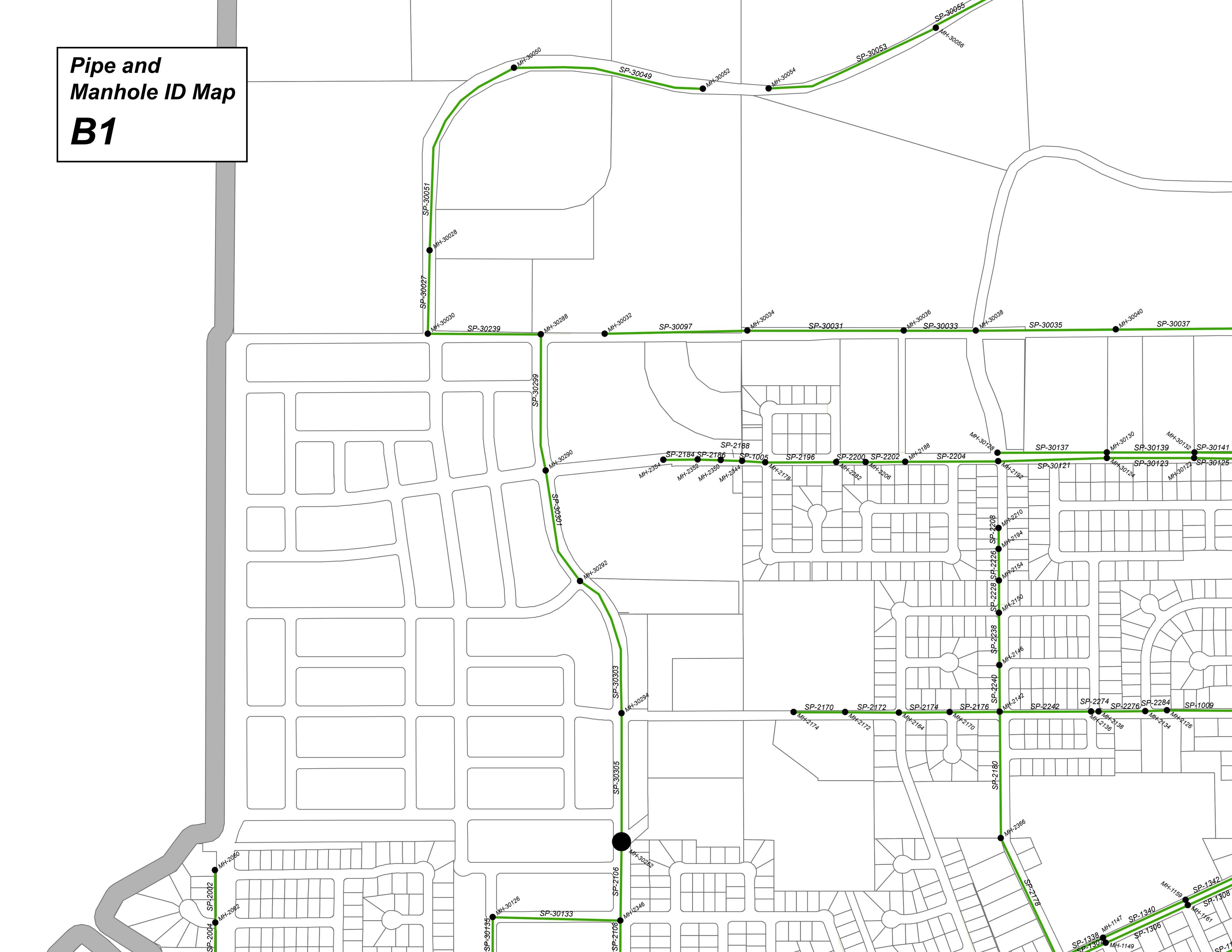


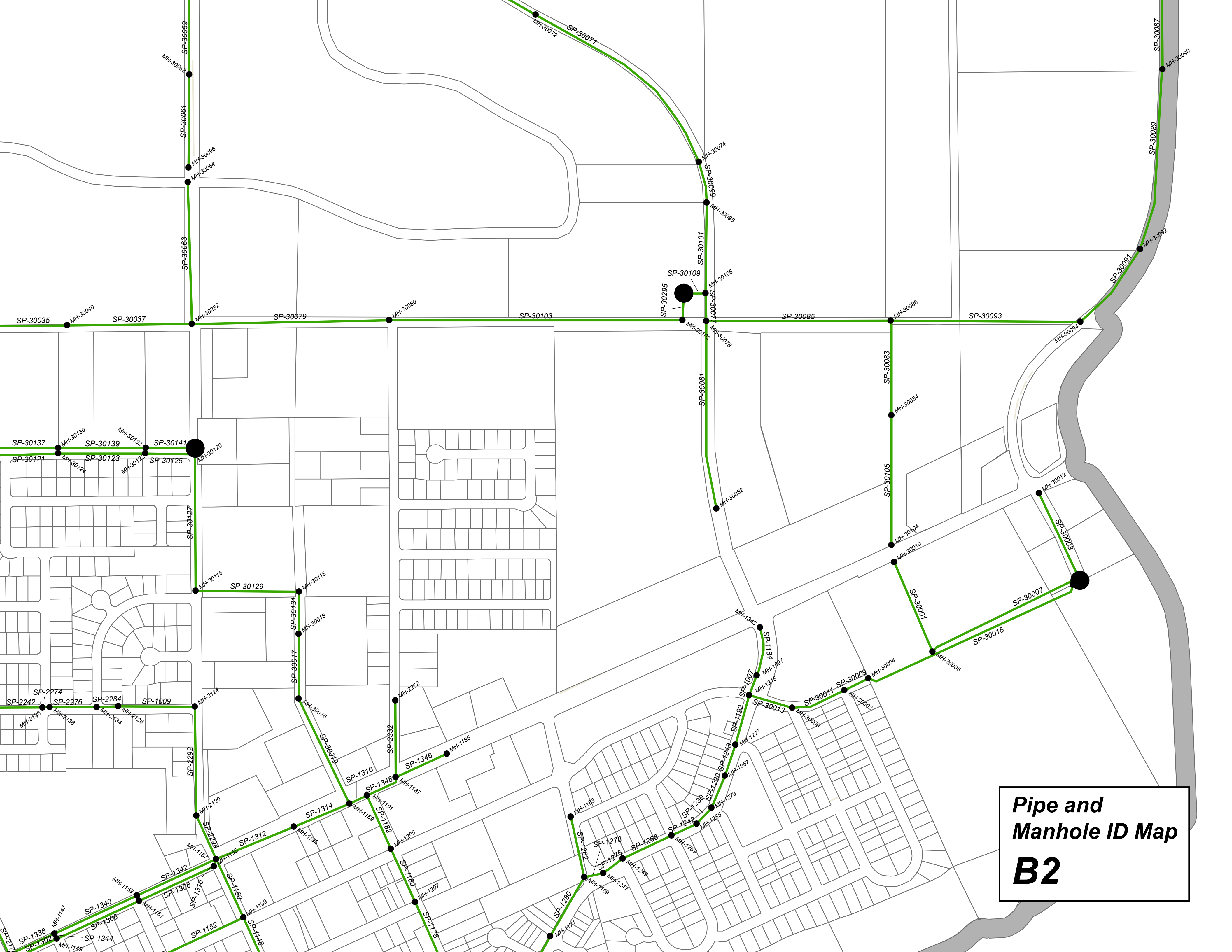
Pipe and Manhole ID Map

A2

Pipe and Manhole ID Map

B1



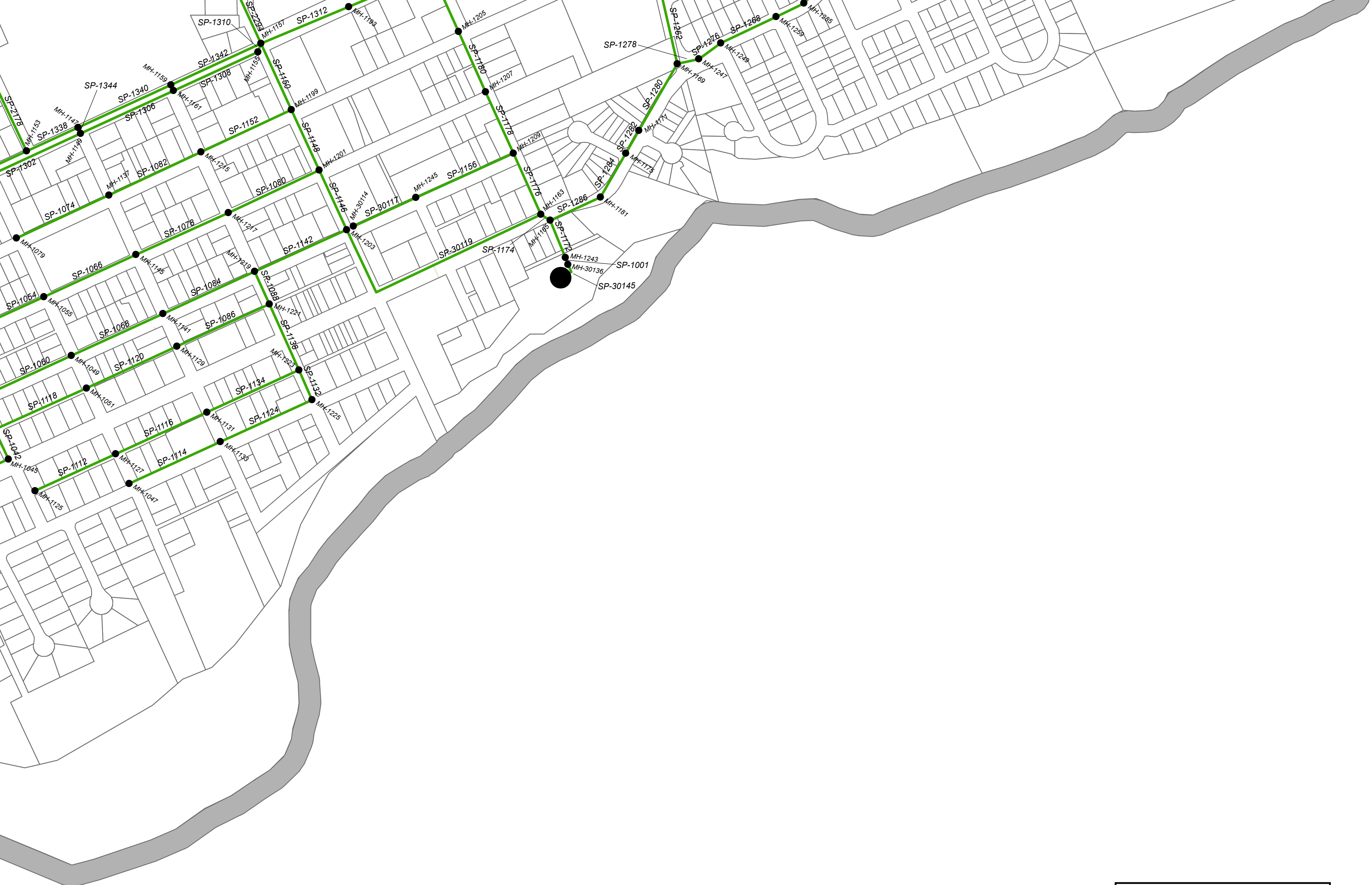


Pipe and Manhole ID Map

B2

Pipe and Manhole ID Map

C1

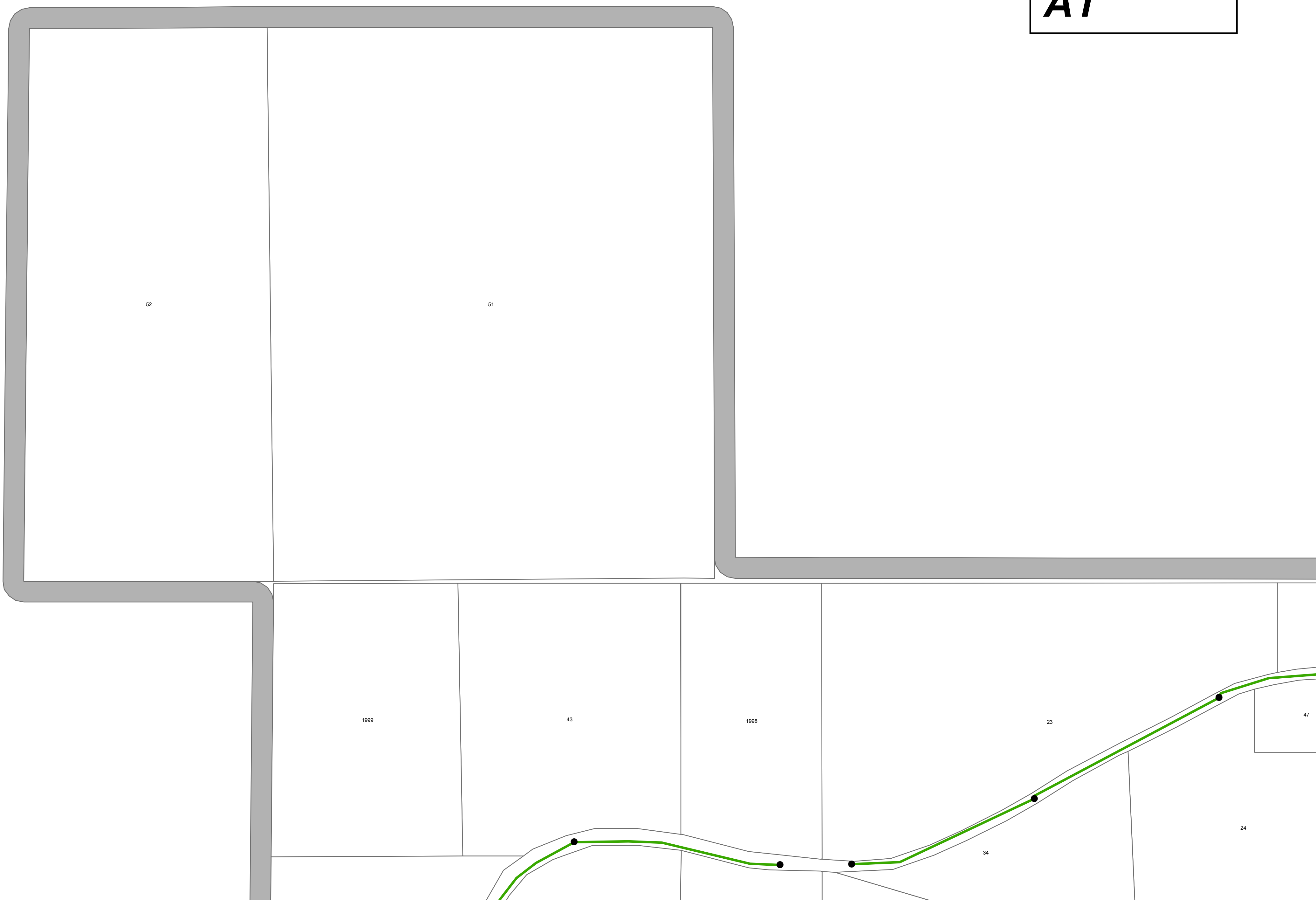


Pipe and Manhole ID Map

C2

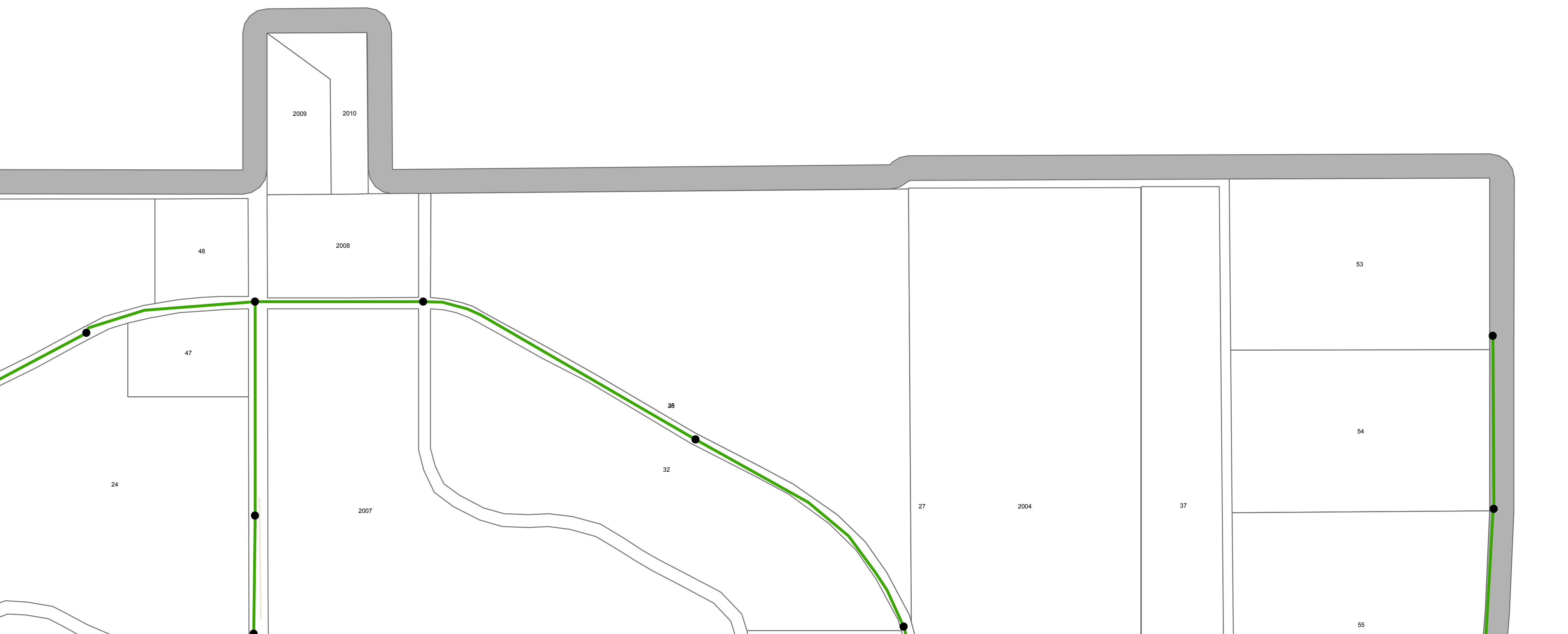
Parcel ID Map

A1



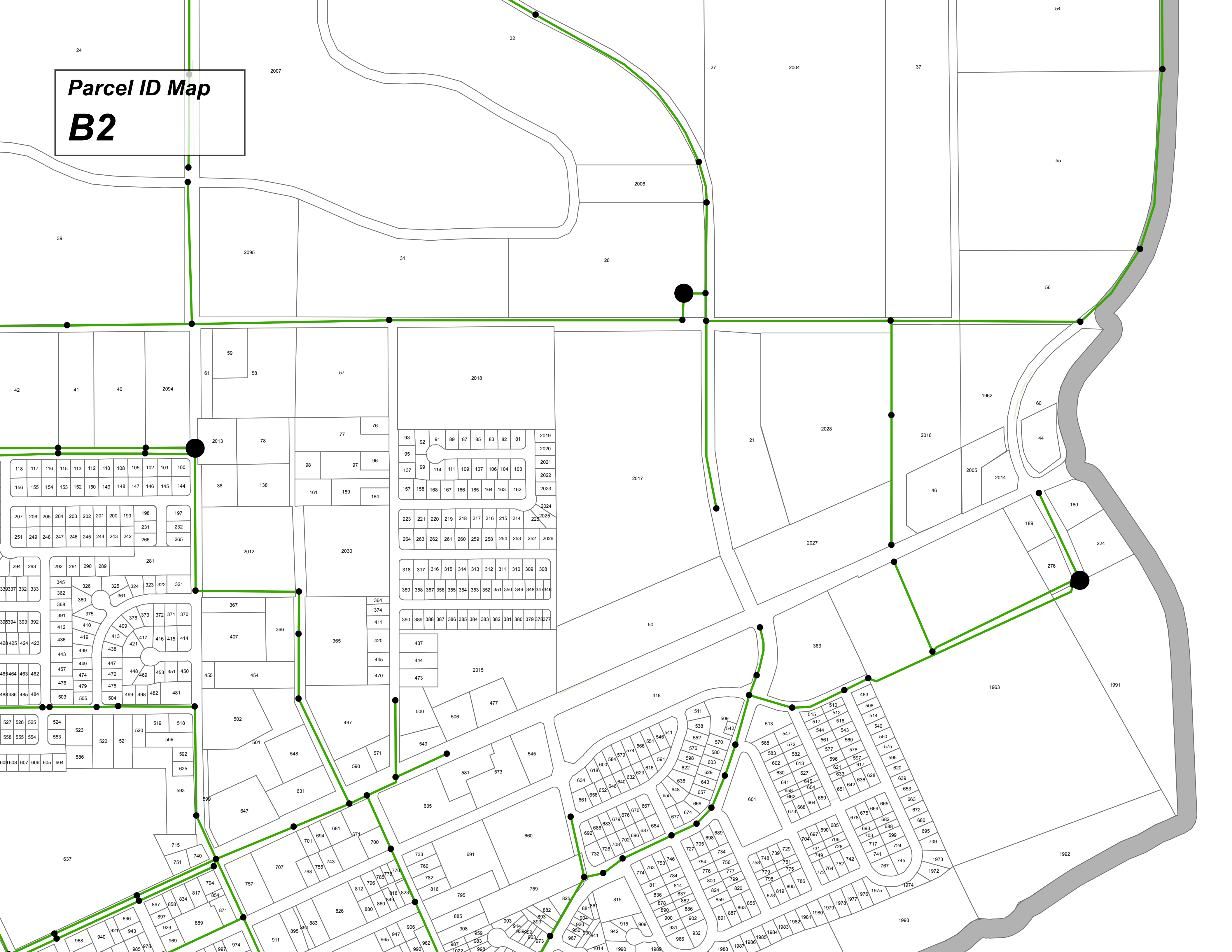
Parcel ID Map

A2



Parcel ID Map

B1


Parcel ID Map
B2

Parcel ID Map

C1

Parcel ID Map

C2

Attributes of parcel_loading_to_manhole.shp

Parcel ID	Existing Land Use	Buildout Land Use	Area (acres)	Area (ft^2)	I/I (gpm)	Buildout ADWF (gpm)	Buildout PWWF (gpm)	Buildout PDWF (gpm)	Manhole
0	Vacant	MHR	1.972	85,910	0.822	3.697	11.913	11.091	MH-2298
1	MR	MR	0.214	9,307	0.089	0.188	0.653	0.564	MH-2094
2	MR	MR	0.196	8,536	0.082	0.188	0.646	0.564	MH-2094
3	MR	MR	0.181	7,880	0.075	0.188	0.639	0.564	MH-2094
4	MR	MR	0.169	7,368	0.070	0.188	0.634	0.564	MH-2094
5	MR	MR	0.173	7,531	0.072	0.188	0.636	0.564	MH-2094
6	MR	MR	0.189	8,220	0.079	0.188	0.643	0.564	MH-2094
7	MR	MR	0.226	9,848	0.094	0.188	0.658	0.564	MH-2094
8	MR	MR	0.177	7,702	0.074	0.188	0.638	0.564	MH-2094
9	MR	MR	0.186	8,116	0.078	0.188	0.642	0.564	MH-2094
10	MR	MR	0.162	7,070	0.068	0.188	0.632	0.564	MH-2094
11	MR	MR	0.169	7,353	0.070	0.188	0.634	0.564	MH-2094
12	MR	MR	0.172	7,483	0.072	0.188	0.636	0.564	MH-2094
13	Vacant	MR	2.147	93,532	0.895	3.719	12.052	11.157	MH-30252
14	Vacant	MR	2.428	105,751	1.012	3.500	11.512	10.500	MH-30252
15	Vacant	MR	1.250	54,450	0.521	2.188	7.085	6.564	MH-30252
16	Vacant	LR	2.090	91,050	0.871	2.844	9.403	8.532	MH-30252
17	Vacant	LR	2.214	96,432	0.923	2.188	7.487	6.564	MH-30252
18	Vacant	LR	2.313	100,736	0.964	3.063	10.153	9.189	MH-30252
19	Vacant	LR	2.463	107,291	1.026	3.063	10.215	9.189	MH-30252
20	Vacant	LR	2.473	107,731	1.030	3.063	10.219	9.189	MH-30252
21	Vacant	LR	6.648	289,574	2.770	10.618	34.624	31.854	MH-30082
22	Vacant	NC	4.413	192,225	1.839	7.661	24.822	22.983	MH-30252
23	Vacant	MR	47.030	2,048,610	19.597	90.533	291.196	271.599	MH-30056
24	Vacant	OS	25.930	1,129,521	10.805	0.000	10.805	0.000	MH-30056
25	Vacant	PQP	30.722	1,338,243	12.802	41.521	137.365	124.563	MH-30034
26	Vacant	PQP	12.672	552,013	5.280	24.306	78.198	72.918	MH-30098
27	PR	PR	5.183	225,784	2.160	0.720	2.880	0.720	MH-30072
28	Vacant	PR	42.809	1,864,768	17.839	5.946	23.785	5.946	MH-30068
29	Vacant	HR	5.004	217,962	2.085	18.765	58.380	56.295	MH-30252
30	Vacant	MHR	2.058	89,625	0.858	3.859	12.435	11.577	MH-30128
31	Vacant	MHR	11.578	504,355	4.825	21.709	69.952	65.127	MH-30080
32	Vacant	MHR	24.510	1,067,671	10.213	45.956	148.081	137.868	MH-30068
33	Vacant	MHR	2.058	89,625	0.858	3.859	12.435	11.577	MH-30128
34	Vacant	PR	14.148	616,280	5.895	1.965	7.860	1.965	MH-30054
35	Vacant	PR	42.809	1,864,768	17.839	5.946	23.785	5.946	MH-30068
36	Vacant	NC	4.413	192,225	1.839	7.661	24.822	22.983	MH-30252
37	Vacant	HI	19.992	870,860	8.331	69.417	216.582	208.251	MH-30086
38	Vacant	HR	0.943	41,094	0.393	3.536	11.001	10.608	MH-30120
39	Vacant	LR	22.401	975,778	9.334	35.779	116.671	107.337	MH-30040
40	Vacant	LR	3.725	162,281	1.552	5.950	19.402	17.850	MH-30132
41	Vacant	LR	2.553	111,189	1.064	4.078	13.298	12.234	MH-30130
42	Vacant	LR	6.002	261,461	2.501	9.587	31.262	28.761	MH-30130
43	Vacant	PQP	29.945	1,304,404	12.478	52.083	168.727	156.249	MH-30252
44	Vacant	HSC	1.218	53,035	0.508	2.115	6.853	6.345	MH-30094
45	Vacant	OS	3.539	154,163	1.475	0.000	1.475	0.000	MH-2352
46	Vacant	HSC	2.213	96,384	0.922	3.842	12.448	11.526	MH-30104
47	Vacant	PQP	3.901	169,921	1.626	9.482	30.072	28.446	MH-30058
48	Vacant	HR	3.611	157,297	1.505	13.541	42.128	40.623	MH-30058
49	Vacant	PR	1.468	63,927	0.612	0.204	0.816	0.204	MH-2350
50	Vacant	PC	7.304	318,167	3.044	12.681	41.087	38.043	MH-1343
51	PQP	PQP	129.304	5,632,461	53.881	0.000	53.881	0.000	MH-30252
52	PQP	PQP	71.224	3,102,539	29.679	0.000	29.679	0.000	MH-30252
53	Vacant	HI	17.253	751,548	7.189	59.906	186.907	179.718	MH-30088
54	Vacant	LI	16.173	704,489	6.739	22.462	74.125	67.386	MH-30088
55	Vacant	LI	21.837	951,199	9.099	30.329	100.086	90.987	MH-30090
56	Vacant	LI	6.952	302,849	2.897	9.656	31.865	28.968	MH-30092
57	Vacant	LR	5.203	226,663	2.168	8.310	27.098	24.930	MH-2262
58	Vacant	HR	3.606	157,092	1.503	13.523	42.072	40.569	MH-2262
59	Vacant	HR	1.084	47,211	0.452	4.065	12.647	12.195	MH-2262
60	Vacant	LI	2.110	91,908	0.879	2.931	9.672	8.793	MH-30094
61	Vacant	HR	0.646	28,158	0.269	2.422	7.535	7.266	MH-30120
62	Vacant	PQP	4.215	183,606	1.756	1.859	7.333	5.577	MH-2206
63	Vacant	LR	2.806	122,229	1.169	4.482	14.615	13.446	MH-2282
64	Vacant	MR	0.162	7,071	0.068	0.312	1.004	0.936	MH-2282
65	Vacant	MR	0.142	6,206	0.059	0.273	0.878	0.819	MH-2282
66	Vacant	MR	0.142	6,206	0.059	0.273	0.878	0.819	MH-2282
67	Vacant	MR	0.142	6,206	0.059	0.273	0.878	0.819	MH-2282
68	Vacant	MR	0.138	6,028	0.058	0.266	0.856	0.798	MH-2282
69	Vacant	MR	0.191	8,300	0.080	0.368	1.184	1.104	MH-2282
70	Vacant	MR	0.185	8,055	0.077	0.356	1.145	1.068	MH-2282
71	Vacant	MR	0.149	6,477	0.062	0.287	0.923	0.861	MH-2178
72	Vacant	MR	0.180	7,850	0.075	0.346	1.113	1.038	MH-2282
73	Vacant	MR	0.178	7,770	0.074	0.343	1.103	1.029	MH-2282
74	Vacant	MR	0.178	7,770	0.074	0.343	1.103	1.029	MH-2282
75	Vacant	MR	0.198	8,630	0.083	0.381	1.226	1.143	MH-2282
76	LR	LR	0.310	13,500	0.129	0.219	0.786	0.657	MH-2262
77	LR	LR	1.715	74,701	0.715	0.219	1.372	0.657	MH-2262
78	Vacant	HR	1.520	66,220	0.633	5.700	17.733	17.100	MH-2262
79	Vacant	MR	0.037	1,593	0.015	0.071	0.228	0.213	MH-2178
80	Vacant	MR	0.158	6,888	0.066	0.304	0.978	0.912	MH-2178
81	MR	MR	0.184	8,025	0.077	0.188	0.641	0.564	MH-2262
82	MR	MR	0.156	6,813	0.065	0.188	0.629	0.564	MH-2262
83	MR	MR	0.162	7,055	0.068	0.188	0.632	0.564	MH-2262
84	Vacant	MR	0.182	7,941	0.076	0.350	1.126	1.050	MH-2282
85	MR	MR	0.178	7,748	0.074	0.188	0.638	0.564	MH-2262
86	Vacant	MR	0.180	7,849	0.075	0.346	1.113	1.038	MH-2178
87	MR	MR	0.155	6,740	0.065	0.188	0.629	0.564	MH-2262
88	Vacant	MR	0.181	7,867	0.075	0.348	1.119	1.044	MH-2178
89	MR	MR	0.163	7,086	0.068	0.188	0.632	0.564	MH-2262
90	Vacant	MR	0.201	8,759	0.084	0.387	1.245	1.161	MH-2178
91	MR	MR	0.166	7,241	0.069	0.188	0.633	0.564	MH-2262
92	MR	MR	0.212	9,236	0.088	0.188	0.652	0.564	MH-2262
93	MR	MR	0.163	7,109	0.068	0.188	0.632	0.564	MH-2262
94	Vacant	MR	0.180	7,833	0.075	0.346	1.113	1.038	MH-2178
95	MR	MR	0.171	7,455	0.071	0.188	0.635	0.564	MH-2262
96	Vacant	LR	0.340	14,832	0.142	0.543	1.771	1.629	MH-2262
97	Vacant	LR	0.834	36,351	0.348	1.332	4.344	3.996	MH-2262
98	Vacant	LR	0.441	19,215	0.184	0.704	2.296	2.112	MH-2262
99	MR	MR	0.216	9,409	0.090	0.188	0.654	0.564	MH-2262
100	MR	MR	0.205	8,942	0.085	0.188	0.649	0.564	MH-2138
101	MR	MR	0.167	7,283	0.070	0.188	0.634	0.564	MH-2138
102	MR	MR	0.170	7,385	0.071	0.188	0.635	0.564	MH-2138
103	MR	MR	0.198	8,616	0.083	0.188	0.647	0.564	MH-2262
104	MR	MR	0.164	7,152	0.068	0.188	0.632	0.564	MH-2262
105	MR	MR	0.163	7,119	0.068	0.188	0.632	0.564	MH-2138
106	MR	MR	0.157	6,848	0.065	0.188	0.629	0.564	MH-2262
107	MR	MR	0.192	8,352	0.080	0.188	0.644	0.564	MH-2262
108	MR	MR	0.165	7,184	0.069	0.188	0.633	0.564	MH-2138
109	MR	MR	0.180	7,819	0.075	0.188	0.639	0.564	MH-2262
110	MR	MR	0.172	7,485	0.072	0.188	0.636	0.564	MH-2138
111	MR	MR	0.169	7,362	0.070	0.188	0.634	0.564	MH-2262
112	MR	MR	0.165	7,193	0.069	0.188	0.633	0.564	MH-30124
113	MR	MR	0.159	6,912	0.066	0.188	0.630	0.564	MH-30124
114	MR	MR	0.173	7,558	0.072	0.188	0.636	0.564	MH-2262
115	MR	MR	0.164	7,153	0.068	0.188	0.632	0.564	MH-30124
116	MR	MR	0.169	7,368	0.070	0.188	0.634	0.564	MH-30124
117	MR	MR	0.172	7,502	0.072	0.188	0.636	0.564	MH-30124

Attributes of parcel_loading_to_manhole.shp

Parcel ID	Existing Land Use	Buildout Land Use	Area (acres)	Area (ft^2)	I/I (gpm)	Buildout ADWF (gpm)	Buildout PWWF (gpm)	Buildout PDWF (gpm)	Manhole
118	MR	MR	0.192	8,378	0.080	0.188	0.644	0.564	MH-30124
119	MR	MR	0.201	8,758	0.084	0.188	0.648	0.564	MH-2150
120	MR	MR	0.165	7,186	0.069	0.188	0.633	0.564	MH-2210
121	MR	MR	0.160	6,967	0.067	0.188	0.631	0.564	MH-2210
122	MR	MR	0.160	6,987	0.067	0.188	0.631	0.564	MH-2210
123	MR	MR	0.172	7,504	0.072	0.188	0.636	0.564	MH-2188
124	MR	MR	0.167	7,279	0.070	0.188	0.634	0.564	MH-2188
125	MR	MR	0.159	6,923	0.066	0.188	0.630	0.564	MH-2188
126	MR	MR	0.174	7,601	0.073	0.188	0.637	0.564	MH-2188
127	MR	MR	0.165	7,189	0.069	0.188	0.633	0.564	MH-2206
128	MR	MR	0.169	7,379	0.070	0.188	0.634	0.564	MH-2206
129	MR	MR	0.163	7,084	0.068	0.188	0.632	0.564	MH-2206
130	MR	MR	0.149	6,509	0.062	0.188	0.626	0.564	MH-2282
131	MR	MR	0.334	14,530	0.139	0.188	0.703	0.564	MH-2282
132	MR	MR	0.197	8,572	0.082	0.188	0.646	0.564	MH-2178
133	MR	MR	0.186	8,099	0.078	0.188	0.642	0.564	MH-2178
134	MR	MR	0.184	8,002	0.077	0.188	0.641	0.564	MH-2178
135	MR	MR	0.201	8,734	0.084	0.188	0.648	0.564	MH-2344
136	PQP	PQP	0.163	7,105	0.068	0.204	0.680	0.612	MH-2344
137	MR	MR	0.169	7,374	0.070	0.188	0.634	0.564	MH-2262
138	Vacant	HR	1.386	60,360	0.578	5.197	16.169	15.591	MH-2262
139	MR	MR	0.136	5,935	0.057	0.188	0.621	0.564	MH-2210
140	MR	MR	0.132	5,731	0.055	0.188	0.619	0.564	MH-2210
141	MR	MR	0.138	5,996	0.058	0.188	0.622	0.564	MH-2210
142	MR	MR	0.167	7,254	0.070	0.188	0.634	0.564	MH-2150
143	MR	MR	0.182	7,917	0.076	0.188	0.640	0.564	MH-2178
144	MR	MR	0.217	9,448	0.090	0.188	0.654	0.564	MH-2138
145	MR	MR	0.177	7,727	0.074	0.188	0.638	0.564	MH-2138
146	MR	MR	0.178	7,754	0.074	0.188	0.638	0.564	MH-2138
147	MR	MR	0.170	7,410	0.071	0.188	0.635	0.564	MH-2138
148	MR	MR	0.173	7,520	0.072	0.188	0.636	0.564	MH-2138
149	MR	MR	0.177	7,728	0.074	0.188	0.638	0.564	MH-2138
150	MR	MR	0.171	7,434	0.071	0.188	0.635	0.564	MH-2138
151	MR	MR	0.193	8,389	0.080	0.188	0.644	0.564	MH-2178
152	MR	MR	0.163	7,116	0.068	0.188	0.632	0.564	MH-2138
153	MR	MR	0.167	7,284	0.070	0.188	0.634	0.564	MH-2138
154	MR	MR	0.173	7,535	0.072	0.188	0.636	0.564	MH-2150
155	MR	MR	0.173	7,520	0.072	0.188	0.636	0.564	MH-2150
156	MR	MR	0.195	8,475	0.081	0.188	0.645	0.564	MH-2150
157	MR	MR	0.189	8,223	0.079	0.188	0.643	0.564	MH-2262
158	MR	MR	0.170	7,406	0.071	0.188	0.635	0.564	MH-2262
159	Vacant	LR	0.648	28,236	0.270	1.035	3.375	3.105	MH-2262
160	Vacant	PC/BP	1.080	47,041	0.450	1.875	6.075	5.625	MH-30012
161	Vacant	LR	0.619	26,981	0.258	0.989	3.225	2.967	MH-2262
162	MR	MR	0.216	9,413	0.090	0.188	0.654	0.564	MH-2262
163	MR	MR	0.165	7,207	0.069	0.188	0.633	0.564	MH-2262
164	MR	MR	0.160	6,981	0.067	0.188	0.631	0.564	MH-2262
165	MR	MR	0.174	7,563	0.073	0.188	0.637	0.564	MH-2262
166	MR	MR	0.166	7,237	0.069	0.188	0.633	0.564	MH-2262
167	MR	MR	0.167	7,279	0.070	0.188	0.634	0.564	MH-2262
168	MR	MR	0.167	7,293	0.070	0.188	0.634	0.564	MH-2262
169	MR	MR	0.161	7,002	0.067	0.188	0.631	0.564	MH-2210
170	MR	MR	0.158	6,893	0.066	0.188	0.630	0.564	MH-2210
171	MR	MR	0.152	6,601	0.063	0.188	0.627	0.564	MH-2210
172	MR	MR	0.166	7,217	0.069	0.188	0.633	0.564	MH-2210
173	MR	MR	0.156	6,776	0.065	0.188	0.629	0.564	MH-2210
174	MR	MR	0.150	6,516	0.063	0.188	0.627	0.564	MH-2210
175	MR	MR	0.176	7,683	0.073	0.188	0.637	0.564	MH-2210
176	MR	MR	0.210	9,135	0.088	0.188	0.652	0.564	MH-2210
177	MR	MR	0.189	8,237	0.079	0.188	0.643	0.564	MH-2210
178	MR	MR	0.205	8,948	0.085	0.188	0.649	0.564	MH-2210
179	MR	MR	0.143	6,209	0.060	0.188	0.624	0.564	MH-2210
180	MR	MR	0.147	6,400	0.061	0.188	0.625	0.564	MH-2210
181	MR	MR	0.141	6,135	0.059	0.188	0.623	0.564	MH-2210
182	MR	MR	0.227	9,904	0.095	0.188	0.659	0.564	MH-2210
183	MR	MR	0.185	8,056	0.077	0.188	0.641	0.564	MH-2150
184	LR	LR	0.316	13,752	0.132	0.219	0.789	0.657	MH-2262
185	MR	MR	0.190	8,295	0.079	0.188	0.643	0.564	MH-2178
186	MR	MR	0.203	8,843	0.085	0.188	0.649	0.564	MH-2178
187	MR	MR	0.140	6,090	0.058	0.188	0.622	0.564	MH-2210
188	MR	MR	0.139	6,035	0.058	0.188	0.622	0.564	MH-2210
189	Vacant	PC/BP	0.974	42,411	0.406	1.691	5.479	5.073	MH-30012
190	MR	MR	0.133	5,776	0.055	0.188	0.619	0.564	MH-2210
191	MR	MR	0.203	8,861	0.085	0.188	0.649	0.564	MH-2210
192	MR	MR	0.172	7,510	0.072	0.188	0.636	0.564	MH-2150
193	MR	MR	0.143	6,228	0.060	0.188	0.624	0.564	MH-2210
194	MR	MR	0.137	5,989	0.057	0.188	0.621	0.564	MH-2210
195	MR	MR	0.191	8,340	0.080	0.188	0.644	0.564	MH-2210
196	MR	MR	0.186	8,112	0.078	0.188	0.642	0.564	MH-2178
197	MR	MR	0.238	10,371	0.099	0.188	0.663	0.564	MH-2124
198	MR	MR	0.219	9,526	0.091	0.188	0.655	0.564	MH-2138
199	MR	MR	0.177	7,714	0.074	0.188	0.638	0.564	MH-2138
200	MR	MR	0.177	7,718	0.074	0.188	0.638	0.564	MH-2138
201	MR	MR	0.171	7,456	0.071	0.188	0.635	0.564	MH-2138
202	MR	MR	0.171	7,447	0.071	0.188	0.635	0.564	MH-2138
203	MR	MR	0.185	8,051	0.077	0.188	0.641	0.564	MH-2138
204	MR	MR	0.173	7,529	0.072	0.188	0.636	0.564	MH-2138
205	MR	MR	0.161	7,026	0.067	0.188	0.631	0.564	MH-2150
206	MR	MR	0.182	7,925	0.076	0.188	0.640	0.564	MH-2150
207	MR	MR	0.199	8,681	0.083	0.188	0.647	0.564	MH-2150
208	MR	MR	0.191	8,318	0.080	0.188	0.644	0.564	MH-2210
209	MR	MR	0.160	6,972	0.067	0.188	0.631	0.564	MH-2210
210	MR	MR	0.164	7,159	0.068	0.188	0.632	0.564	MH-2210
211	MR	MR	0.158	6,868	0.066	0.188	0.630	0.564	MH-2210
212	MR	MR	0.154	6,723	0.064	0.188	0.628	0.564	MH-2210
213	MR	MR	0.171	7,433	0.071	0.188	0.635	0.564	MH-2210
214	MR	MR	0.166	7,249	0.069	0.188	0.633	0.564	MH-2262
215	MR	MR	0.153	6,679	0.064	0.188	0.628	0.564	MH-2262
216	MR	MR	0.176	7,674	0.073	0.188	0.637	0.564	MH-2262
217	MR	MR	0.146	6,362	0.061	0.188	0.625	0.564	MH-2262
218	MR	MR	0.186	8,093	0.078	0.188	0.642	0.564	MH-2262
219	MR	MR	0.166	7,228	0.069	0.188	0.633	0.564	MH-2262
220	MR	MR	0.167	7,287	0.070	0.188	0.634	0.564	MH-2262
221	MR	MR	0.167	7,296	0.070	0.188	0.634	0.564	MH-2262
222	MR	MR	0.207	9,027	0.086	0.188	0.650	0.564	MH-2178
223	MR	MR	0.186	8,099	0.078	0.188	0.642	0.564	MH-2262
224	Vacant	PC/BP	1.575	68,594	0.656	2.734	8.858	8.202	MH-30012
225	MR	MR	0.170	7,384	0.071	0.188	0.635	0.564	MH-2262
226	MR	MR	0.147	6,408	0.061	0.188	0.625	0.564	MH-2210
227	MR	MR	0.147	6,401	0.061	0.188	0.625	0.564	MH-2210
228	MR	MR	0.130	5,660	0.054	0.188	0.618	0.564	MH-2210
229	MR	MR	0.169	7,371	0.070	0.188	0.634	0.564	MH-2150
230	MR	MR	0.186	8,102	0.078	0.188	0.642	0.564	MH-2178
231	MR	MR	0.171	7,441	0.071	0.188	0.635	0.564	MH-2138
232	MR	MR	0.175	7,636	0.073	0.188	0.637	0.564	MH-2124
233	MR	MR	0.141	6,141	0.059	0.188	0.623	0.564	MH-2210
234	MR	MR	0.159	6,925	0.066	0.188	0.630	0.564	MH-2210
235	MR	MR	0.131	5,699	0.055	0.188	0.619	0.564	MH-2210

Attributes of parcel_loading_to_manhole.shp

Parcel ID	Existing Land Use	Buildout Land Use	Area (acres)	Area (ft^2)	I/I (gpm)	Buildout ADWF (gpm)	Buildout PWWF (gpm)	Buildout PDWF (gpm)	Manhole
236	MR	MR	0.164	7,136	0.068	0.188	0.632	0.564	MH-2210
237	MR	MR	0.165	7,197	0.069	0.188	0.633	0.564	MH-2210
238	MR	MR	0.142	6,182	0.059	0.188	0.623	0.564	MH-2210
239	MR	MR	0.149	6,470	0.062	0.188	0.626	0.564	MH-2210
240	MR	MR	0.136	5,942	0.057	0.188	0.621	0.564	MH-2210
241	MR	MR	0.197	8,596	0.082	0.188	0.646	0.564	MH-2178
242	MR	MR	0.177	7,708	0.074	0.188	0.638	0.564	MH-2138
243	MR	MR	0.176	7,663	0.073	0.188	0.637	0.564	MH-2138
244	MR	MR	0.170	7,422	0.071	0.188	0.635	0.564	MH-2138
245	MR	MR	0.169	7,358	0.070	0.188	0.634	0.564	MH-2138
246	MR	MR	0.183	7,951	0.076	0.188	0.640	0.564	MH-2138
247	MR	MR	0.171	7,455	0.071	0.188	0.635	0.564	MH-2138
248	MR	MR	0.161	7,029	0.067	0.188	0.631	0.564	MH-2150
249	MR	MR	0.179	7,790	0.075	0.188	0.639	0.564	MH-2150
250	MR	MR	0.173	7,557	0.072	0.188	0.636	0.564	MH-2150
251	MR	MR	0.197	8,598	0.082	0.188	0.646	0.564	MH-2150
252	MR	MR	0.204	8,900	0.085	0.188	0.649	0.564	MH-2262
253	MR	MR	0.190	8,275	0.079	0.188	0.643	0.564	MH-2262
254	MR	MR	0.177	7,717	0.074	0.188	0.638	0.564	MH-2262
255	MR	MR	0.157	6,851	0.065	0.188	0.629	0.564	MH-2210
256	MR	MR	0.164	7,144	0.068	0.188	0.632	0.564	MH-2210
257	MR	MR	0.156	6,777	0.065	0.188	0.629	0.564	MH-2210
258	MR	MR	0.196	8,533	0.082	0.188	0.646	0.564	MH-2262
259	MR	MR	0.171	7,462	0.071	0.188	0.635	0.564	MH-2262
260	MR	MR	0.177	7,690	0.074	0.188	0.638	0.564	MH-2262
261	MR	MR	0.185	8,061	0.077	0.188	0.641	0.564	MH-2262
262	MR	MR	0.195	8,504	0.081	0.188	0.645	0.564	MH-2262
263	MR	MR	0.165	7,185	0.069	0.188	0.633	0.564	MH-2262
264	MR	MR	0.193	8,386	0.080	0.188	0.644	0.564	MH-2262
265	MR	MR	0.208	9,045	0.087	0.188	0.651	0.564	MH-2124
266	MR	MR	0.184	8,001	0.077	0.188	0.641	0.564	MH-2138
267	Vacant	MR	0.137	5,986	0.057	0.264	0.849	0.792	MH-2210
268	MR	MR	0.171	7,470	0.071	0.188	0.635	0.564	MH-2178
269	MR	MR	0.136	5,917	0.057	0.188	0.621	0.564	MH-2194
270	MR	MR	0.150	6,540	0.063	0.188	0.627	0.564	MH-2210
271	MR	MR	0.151	6,556	0.063	0.188	0.627	0.564	MH-2210
272	MR	MR	0.127	5,538	0.053	0.188	0.617	0.564	MH-2194
273	MR	MR	0.156	6,777	0.065	0.188	0.629	0.564	MH-2210
274	MR	MR	0.147	6,425	0.061	0.188	0.625	0.564	MH-2210
275	MR	MR	0.149	6,502	0.062	0.188	0.626	0.564	MH-2210
276	Vacant	PC/BP	0.888	38,675	0.370	1.542	4.996	4.626	MH-30012
277	MR	MR	0.173	7,556	0.072	0.188	0.636	0.564	MH-2150
278	Vacant	MR	0.179	7,780	0.075	0.345	1.110	1.035	MH-2210
279	MR	MR	0.156	6,788	0.065	0.188	0.629	0.564	MH-2194
280	MR	MR	0.138	5,995	0.058	0.188	0.622	0.564	MH-2194
281	MR	MR	1.331	57,969	0.555	0.188	1.119	0.564	MH-2138
282	Vacant	MR	0.140	6,088	0.058	0.269	0.865	0.807	MH-2210
283	MR	MR	0.220	9,601	0.092	0.188	0.656	0.564	MH-2150
284	MR	MR	0.249	10,864	0.104	0.188	0.668	0.564	MH-2210
285	MR	MR	0.206	8,989	0.086	0.188	0.650	0.564	MH-2210
286	MR	MR	0.143	6,216	0.060	0.188	0.624	0.564	MH-2154
287	MR	MR	0.182	7,911	0.076	0.188	0.640	0.564	MH-2150
288	MR	MR	0.139	6,042	0.058	0.188	0.622	0.564	MH-2154
289	MR	MR	0.176	7,675	0.073	0.188	0.637	0.564	MH-2138
290	MR	MR	0.194	8,472	0.081	0.188	0.645	0.564	MH-2138
291	MR	MR	0.160	6,973	0.067	0.188	0.631	0.564	MH-2138
292	MR	MR	0.208	9,051	0.087	0.188	0.651	0.564	MH-2138
293	MR	MR	0.199	8,690	0.083	0.188	0.647	0.564	MH-2150
294	MR	MR	0.165	7,193	0.069	0.188	0.633	0.564	MH-2150
295	MR	MR	0.153	6,670	0.064	0.188	0.628	0.564	MH-2210
296	MR	MR	0.151	6,575	0.063	0.188	0.627	0.564	MH-2210
297	MR	MR	0.181	7,864	0.075	0.188	0.639	0.564	MH-2210
298	MR	MR	0.162	7,044	0.068	0.188	0.632	0.564	MH-2210
299	MR	MR	0.176	7,669	0.073	0.188	0.637	0.564	MH-2210
300	MR	MR	0.170	7,411	0.071	0.188	0.635	0.564	MH-2210
301	MR	MR	0.169	7,367	0.070	0.188	0.634	0.564	MH-2210
302	MR	MR	0.184	8,030	0.077	0.188	0.641	0.564	MH-2210
303	MR	MR	0.165	7,204	0.069	0.188	0.633	0.564	MH-2210
304	MR	MR	0.181	7,898	0.075	0.188	0.639	0.564	MH-2210
305	MR	MR	0.187	8,137	0.078	0.188	0.642	0.564	MH-2210
306	MR	MR	0.180	7,838	0.075	0.188	0.639	0.564	MH-2210
307	MR	MR	0.167	7,253	0.070	0.188	0.634	0.564	MH-2210
308	MR	MR	0.199	8,676	0.083	0.188	0.647	0.564	MH-2262
309	MR	MR	0.164	7,146	0.068	0.188	0.632	0.564	MH-2262
310	MR	MR	0.179	7,781	0.075	0.188	0.639	0.564	MH-2262
311	MR	MR	0.175	7,613	0.073	0.188	0.637	0.564	MH-2262
312	MR	MR	0.175	7,607	0.073	0.188	0.637	0.564	MH-2262
313	MR	MR	0.182	7,942	0.076	0.188	0.640	0.564	MH-2262
314	MR	MR	0.166	7,230	0.069	0.188	0.633	0.564	MH-2262
315	MR	MR	0.184	8,002	0.077	0.188	0.641	0.564	MH-2262
316	MR	MR	0.168	7,332	0.070	0.188	0.634	0.564	MH-2262
317	MR	MR	0.193	8,407	0.080	0.188	0.644	0.564	MH-2262
318	MR	MR	0.182	7,921	0.076	0.188	0.640	0.564	MH-2262
319	MR	MR	0.137	5,955	0.057	0.188	0.621	0.564	MH-2154
320	MR	MR	0.130	5,649	0.054	0.188	0.618	0.564	MH-2154
321	MR	MR	0.282	12,298	0.118	0.188	0.682	0.564	MH-2134
322	MR	MR	0.130	5,656	0.054	0.188	0.618	0.564	MH-2134
323	MR	MR	0.149	6,482	0.062	0.188	0.626	0.564	MH-2134
324	MR	MR	0.188	8,177	0.078	0.188	0.642	0.564	MH-2134
325	MR	MR	0.252	10,956	0.105	0.188	0.669	0.564	MH-2134
326	MR	MR	0.278	12,089	0.116	0.188	0.680	0.564	MH-2134
327	MR	MR	0.185	8,044	0.077	0.188	0.641	0.564	MH-2150
328	MR	MR	0.177	7,701	0.074	0.188	0.638	0.564	MH-2150
329	MR	MR	0.192	8,371	0.080	0.188	0.644	0.564	MH-2150
330	MR	MR	0.195	8,479	0.081	0.188	0.645	0.564	MH-2150
331	MR	MR	0.170	7,423	0.071	0.188	0.635	0.564	MH-2150
332	MR	MR	0.189	8,252	0.079	0.188	0.643	0.564	MH-2150
333	MR	MR	0.195	8,511	0.081	0.188	0.645	0.564	MH-2138
334	MR	MR	0.201	8,745	0.084	0.188	0.648	0.564	MH-2150
335	MR	MR	0.214	9,325	0.089	0.188	0.653	0.564	MH-2150
336	MR	MR	0.184	8,004	0.077	0.188	0.641	0.564	MH-2150
337	MR	MR	0.169	7,352	0.070	0.188	0.634	0.564	MH-2150
338	MR	MR	0.246	10,708	0.103	0.188	0.667	0.564	MH-2150
339	MR	MR	0.185	8,067	0.077	0.188	0.641	0.564	MH-2150
340	MR	MR	0.190	8,297	0.079	0.188	0.643	0.564	MH-2150
341	MR	MR	0.183	7,991	0.076	0.188	0.640	0.564	MH-2150
342	MR	MR	0.189	8,246	0.079	0.188	0.643	0.564	MH-2150
343	PQP	PQP	10.694	465,843	4.456	20.833	66.955	62.499	MH-2174
344	MR	MR	0.245	10,677	0.102	0.188	0.666	0.564	MH-2150
345	MR	MR	0.150	6,518	0.063	0.188	0.627	0.564	MH-2138
346	MR	MR	0.090	3,936	0.038	0.188	0.602	0.564	MH-2262
347	MR	MR	0.102	4,461	0.043	0.188	0.607	0.564	MH-2262
348	MR	MR	0.127	5,543	0.053	0.188	0.617	0.564	MH-2262
349	MR	MR	0.152	6,628	0.063	0.188	0.627	0.564	MH-2262
350	MR	MR	0.131	5,691	0.055	0.188	0.619	0.564	MH-2262
351	MR	MR	0.137	5,946	0.057	0.188	0.621	0.564	MH-2262
352	MR	MR	0.139	6,075	0.058	0.188	0.622	0.564	MH-2262
353	MR	MR	0.151	6,578	0.063	0.188	0.627	0.564	MH-2262

Attributes of parcel_loading_to_manhole.shp

Parcel ID	Existing Land Use	Buildout Land Use	Area (acres)	Area (ft^2)	I/I (gpm)	Buildout ADWF (gpm)	Buildout PWWF (gpm)	Buildout PDWF (gpm)	Manhole
354	MR	MR	0.146	6,341	0.061	0.188	0.625	0.564	MH-2262
355	MR	MR	0.140	6,085	0.058	0.188	0.622	0.564	MH-2262
356	MR	MR	0.137	5,956	0.057	0.188	0.621	0.564	MH-2262
357	MR	MR	0.122	5,324	0.051	0.188	0.615	0.564	MH-2262
358	MR	MR	0.154	6,719	0.064	0.188	0.628	0.564	MH-2262
359	MR	MR	0.166	7,219	0.069	0.188	0.633	0.564	MH-2262
360	MR	MR	0.230	10,038	0.096	0.188	0.660	0.564	MH-2134
361	MR	MR	0.171	7,457	0.071	0.188	0.635	0.564	MH-2134
362	MR	MR	0.152	6,628	0.063	0.188	0.627	0.564	MH-2138
363	Vacant	PC	4.442	193,490	1.851	7.712	24.987	23.136	MH-1343
364	HR	HR	0.112	4,892	0.047	0.212	0.683	0.636	MH-2262
365	HR	HR	3.425	149,202	1.427	6.493	20.906	19.479	MH-30018
366	OF	OF	1.139	49,610	0.475	1.977	6.406	5.931	MH-30018
367	Vacant	OF	0.609	26,508	0.254	1.057	3.425	3.171	MH-2124
368	MR	MR	0.153	6,680	0.064	0.188	0.628	0.564	MH-2138
369	MR	MR	0.184	8,018	0.077	0.188	0.641	0.564	MH-2164
370	MR	MR	0.197	8,595	0.082	0.188	0.646	0.564	MH-2124
371	MR	MR	0.170	7,399	0.071	0.188	0.635	0.564	MH-2134
372	MR	MR	0.162	7,058	0.068	0.188	0.632	0.564	MH-2134
373	MR	MR	0.184	8,024	0.077	0.188	0.641	0.564	MH-2134
374	HR	HR	0.168	7,338	0.070	0.319	1.027	0.957	MH-2262
375	MR	MR	0.229	9,965	0.095	0.188	0.659	0.564	MH-2134
376	MR	MR	0.180	7,849	0.075	0.188	0.639	0.564	MH-2134
377	MR	MR	0.106	4,608	0.044	0.188	0.608	0.564	MH-2262
378	MR	MR	0.095	4,136	0.040	0.188	0.604	0.564	MH-2262
379	MR	MR	0.142	6,200	0.059	0.188	0.623	0.564	MH-2262
380	MR	MR	0.148	6,439	0.062	0.188	0.626	0.564	MH-2262
381	MR	MR	0.129	5,639	0.054	0.188	0.618	0.564	MH-2262
382	MR	MR	0.157	6,827	0.065	0.188	0.629	0.564	MH-2262
383	MR	MR	0.142	6,184	0.059	0.188	0.623	0.564	MH-2262
384	MR	MR	0.144	6,282	0.060	0.188	0.624	0.564	MH-2262
385	MR	MR	0.133	5,805	0.055	0.188	0.619	0.564	MH-2262
386	MR	MR	0.143	6,228	0.060	0.188	0.624	0.564	MH-2262
387	MR	MR	0.153	6,684	0.064	0.188	0.628	0.564	MH-2262
388	MR	MR	0.133	5,790	0.055	0.188	0.619	0.564	MH-2262
389	MR	MR	0.150	6,524	0.063	0.188	0.627	0.564	MH-2262
390	MR	MR	0.167	7,261	0.070	0.188	0.634	0.564	MH-2262
391	MR	MR	0.154	6,692	0.064	0.188	0.628	0.564	MH-2138
392	MR	MR	0.167	7,287	0.070	0.188	0.634	0.564	MH-2138
393	MR	MR	0.135	5,899	0.056	0.188	0.620	0.564	MH-2150
394	MR	MR	0.163	7,108	0.068	0.188	0.632	0.564	MH-2150
395	MR	MR	0.146	6,344	0.061	0.188	0.625	0.564	MH-2150
396	MR	MR	0.163	7,105	0.068	0.188	0.632	0.564	MH-2150
397	MR	MR	0.148	6,449	0.062	0.188	0.626	0.564	MH-2150
398	MR	MR	0.159	6,948	0.066	0.188	0.630	0.564	MH-2150
399	MR	MR	0.172	7,499	0.072	0.188	0.636	0.564	MH-2150
400	MR	MR	0.135	5,895	0.056	0.188	0.620	0.564	MH-2150
401	MR	MR	0.151	6,566	0.063	0.188	0.627	0.564	MH-2150
402	MR	MR	0.157	6,833	0.065	0.188	0.629	0.564	MH-2150
403	MR	MR	0.154	6,707	0.064	0.188	0.628	0.564	MH-2150
404	MR	MR	0.160	6,973	0.067	0.188	0.631	0.564	MH-2150
405	MR	MR	0.149	6,491	0.062	0.188	0.626	0.564	MH-2150
406	MR	MR	0.159	6,925	0.066	0.188	0.630	0.564	MH-2150
407	OF	OF	1.970	85,822	0.821	3.420	11.081	10.260	MH-2124
408	MR	MR	0.171	7,457	0.071	0.188	0.635	0.564	MH-2164
409	MR	MR	0.156	6,786	0.065	0.188	0.629	0.564	MH-2126
410	MR	MR	0.212	9,230	0.088	0.188	0.652	0.564	MH-2134
411	HR	HR	0.191	8,329	0.080	0.362	1.166	1.086	MH-2262
412	MR	MR	0.163	7,080	0.068	0.188	0.632	0.564	MH-2138
413	MR	MR	0.177	7,689	0.074	0.188	0.638	0.564	MH-2134
414	MR	MR	0.225	9,819	0.094	0.188	0.658	0.564	MH-2124
415	MR	MR	0.193	8,404	0.080	0.188	0.644	0.564	MH-2124
416	MR	MR	0.188	8,202	0.078	0.188	0.642	0.564	MH-2124
417	MR	MR	0.201	8,777	0.084	0.188	0.648	0.564	MH-2124
418	Vacant	PC	5.793	252,345	2.414	10.057	32.585	30.171	MH-1315
419	MR	MR	0.183	7,966	0.076	0.188	0.640	0.564	MH-2134
420	HR	HR	0.329	14,352	0.137	0.624	2.009	1.872	MH-2262
421	MR	MR	0.244	10,641	0.102	0.188	0.666	0.564	MH-2124
422	MR	MR	0.165	7,175	0.069	0.188	0.633	0.564	MH-2164
423	MR	MR	0.151	6,557	0.063	0.188	0.627	0.564	MH-2138
424	MR	MR	0.141	6,132	0.059	0.188	0.623	0.564	MH-2146
425	MR	MR	0.164	7,162	0.068	0.188	0.632	0.564	MH-2146
426	MR	MR	0.167	7,263	0.070	0.188	0.634	0.564	MH-2164
427	MR	MR	0.128	5,592	0.053	0.188	0.617	0.564	MH-2164
428	MR	MR	0.145	6,295	0.060	0.188	0.624	0.564	MH-2146
429	MR	MR	0.152	6,617	0.063	0.188	0.627	0.564	MH-2164
430	MR	MR	0.162	7,071	0.068	0.188	0.632	0.564	MH-2164
431	MR	MR	0.179	7,801	0.075	0.188	0.639	0.564	MH-2146
432	MR	MR	0.249	10,862	0.104	0.188	0.668	0.564	MH-2164
433	MR	MR	0.180	7,849	0.075	0.188	0.639	0.564	MH-2146
434	MR	MR	0.146	6,356	0.061	0.188	0.625	0.564	MH-2146
435	MR	MR	0.148	6,439	0.062	0.188	0.626	0.564	MH-2146
436	MR	MR	0.190	8,264	0.079	0.188	0.643	0.564	MH-2138
437	MHR	MHR	0.446	19,425	0.186	0.188	0.750	0.564	MH-2262
438	MR	MR	0.175	7,614	0.073	0.188	0.637	0.564	MH-2134
439	MR	MR	0.161	7,030	0.067	0.188	0.631	0.564	MH-2134
440	MR	MR	0.166	7,216	0.069	0.188	0.633	0.564	MH-2164
441	MR	MR	0.196	8,558	0.082	0.188	0.646	0.564	MH-2146
442	MR	MR	0.193	8,425	0.080	0.188	0.644	0.564	MH-2164
443	MR	MR	0.218	9,507	0.091	0.188	0.655	0.564	MH-2138
444	MHR	MHR	0.404	17,584	0.168	0.188	0.732	0.564	MH-2262
445	HR	HR	0.197	8,585	0.082	0.373	1.201	1.119	MH-2262
446	MR	MR	0.164	7,151	0.068	0.188	0.632	0.564	MH-2164
447	MR	MR	0.144	6,263	0.060	0.188	0.624	0.564	MH-2134
448	MR	MR	0.302	13,134	0.126	0.188	0.690	0.564	MH-2124
449	MR	MR	0.139	6,073	0.058	0.188	0.622	0.564	MH-2134
450	MR	MR	0.175	7,619	0.073	0.188	0.637	0.564	MH-2124
451	MR	MR	0.162	7,062	0.068	0.188	0.632	0.564	MH-2124
452	MR	MR	0.162	7,044	0.068	0.188	0.632	0.564	MH-2146
453	MR	MR	0.133	5,798	0.055	0.188	0.619	0.564	MH-2124
454	OF	OF	1.338	58,271	0.558	2.323	7.527	6.969	MH-30018
455	Vacant	OF	0.213	9,259	0.089	0.370	1.199	1.110	MH-2124
456	MR	MR	0.255	11,115	0.106	0.188	0.670	0.564	MH-2164
457	MR	MR	0.196	8,546	0.082	0.188	0.646	0.564	MH-2138
458	MR	MR	0.152	6,603	0.063	0.188	0.627	0.564	MH-2164
459	MR	MR	0.149	6,477	0.062	0.188	0.626	0.564	MH-2164
460	MR	MR	0.164	7,142	0.068	0.188	0.632	0.564	MH-2164
461	MR	MR	0.171	7,439	0.071	0.188	0.635	0.564	MH-2164
462	MR	MR	0.153	6,671	0.064	0.188	0.628	0.564	MH-2138
463	MR	MR	0.138	6,017	0.058	0.188	0.622	0.564	MH-2146
464	MR	MR	0.149	6,506	0.062	0.188	0.626	0.564	MH-2146
465	MR	MR	0.158	6,880	0.066	0.188	0.630	0.564	MH-2146
466	MR	MR	0.156	6,787	0.065	0.188	0.629	0.564	MH-2142
467	MR	MR	0.144	6,281	0.060	0.188	0.624	0.564	MH-2146
468	MR	MR	0.145	6,325	0.060	0.188	0.624	0.564	MH-2146
469	MR	MR	0.198	8,612	0.083	0.188	0.647	0.564	MH-2124
470	HR	HR	0.251	10,951	0.105	0.476	1.533	1.428	MH-2262
471	MR	MR	0.165	7,193	0.069	0.188	0.633	0.564	MH-2164

Attributes of parcel_loading_to_manhole.shp

Parcel ID	Existing Land Use	Buildout Land Use	Area (acres)	Area (ft^2)	I/I (gpm)	Buildout ADWF (gpm)	Buildout PWWF (gpm)	Buildout PDWF (gpm)	Manhole
472	MR	MR	0.140	6,108	0.058	0.188	0.622	0.564	MH-2134
473	MHR	MHR	0.442	19,269	0.184	0.188	0.748	0.564	MH-2262
474	MR	MR	0.133	5,790	0.055	0.188	0.619	0.564	MH-2134
475	MR	MR	0.146	6,358	0.061	0.188	0.625	0.564	MH-2146
476	MR	MR	0.190	8,273	0.079	0.188	0.643	0.564	MH-2138
477	CBD	CBD	0.908	39,532	0.378	2.207	6.999	6.621	MH-1185
478	MR	MR	0.152	6,635	0.063	0.188	0.627	0.564	MH-2134
479	MR	MR	0.137	5,968	0.057	0.188	0.621	0.564	MH-2134
480	MR	MR	0.164	7,136	0.068	0.188	0.632	0.564	MH-2164
481	MR	MR	0.440	19,186	0.183	0.188	0.747	0.564	MH-2124
482	MR	MR	0.171	7,428	0.071	0.188	0.635	0.564	MH-2126
483	MR	MR	0.191	8,305	0.080	0.188	0.644	0.564	MH-1315
484	MR	MR	0.155	6,752	0.065	0.188	0.629	0.564	MH-2136
485	MR	MR	0.140	6,113	0.058	0.188	0.622	0.564	MH-2142
486	MR	MR	0.150	6,547	0.063	0.188	0.627	0.564	MH-2142
487	MR	MR	0.282	12,294	0.118	0.188	0.682	0.564	MH-2142
488	MR	MR	0.160	6,981	0.067	0.188	0.631	0.564	MH-2142
489	MR	MR	0.157	6,835	0.065	0.188	0.629	0.564	MH-2142
490	MR	MR	0.161	7,030	0.067	0.188	0.631	0.564	MH-2170
491	MR	MR	0.201	8,746	0.084	0.188	0.648	0.564	MH-2170
492	MR	MR	0.146	6,352	0.061	0.188	0.625	0.564	MH-2142
493	MR	MR	0.146	6,348	0.061	0.188	0.625	0.564	MH-2142
494	MR	MR	0.192	8,348	0.080	0.188	0.644	0.564	MH-2164
495	MR	MR	0.204	8,876	0.085	0.188	0.649	0.564	MH-2170
496	MR	MR	0.208	9,069	0.087	0.188	0.651	0.564	MH-2164
497	CBD	CBD	2.995	130,443	1.248	7.280	23.088	21.840	MH-30016
498	MR	MR	0.150	6,537	0.063	0.188	0.627	0.564	MH-2126
499	MR	MR	0.157	6,822	0.065	0.188	0.629	0.564	MH-2126
500	CBD	CBD	0.911	39,665	0.380	2.214	7.022	6.642	MH-2262
501	Vacant	CBD	2.730	118,931	1.138	6.635	21.043	19.905	MH-30016
502	CBD	CBD	2.193	95,527	0.914	5.330	16.904	15.990	MH-2124
503	MR	MR	0.219	9,541	0.091	0.188	0.655	0.564	MH-2138
504	MR	MR	0.163	7,083	0.068	0.188	0.632	0.564	MH-2134
505	MR	MR	0.149	6,497	0.062	0.188	0.626	0.564	MH-2134
506	CBD	CBD	0.844	36,771	0.352	2.051	6.505	6.153	MH-1185
507	MR	MR	0.179	7,780	0.075	0.188	0.639	0.564	MH-2164
508	MR	MR	0.140	6,093	0.058	0.188	0.622	0.564	MH-1315
509	Vacant	NC	0.660	28,744	0.275	1.146	3.713	3.438	MH-1315
510	MR	MR	0.110	4,772	0.046	0.188	0.610	0.564	MH-1315
511	MR	MR	0.189	8,223	0.079	0.188	0.643	0.564	MH-1259
512	MR	MR	0.110	4,804	0.046	0.188	0.610	0.564	MH-1315
513	Vacant	NC	0.634	27,618	0.264	1.101	3.567	3.303	MH-1315
514	MR	MR	0.154	6,727	0.064	0.188	0.628	0.564	MH-1315
515	MR	MR	0.123	5,371	0.051	0.188	0.615	0.564	MH-1315
516	MR	MR	0.148	6,442	0.062	0.188	0.626	0.564	MH-1315
517	MR	MR	0.112	4,899	0.047	0.188	0.611	0.564	MH-1315
518	MR	MR	0.272	11,837	0.113	0.188	0.677	0.564	MH-2124
519	MR	MR	0.277	12,063	0.115	0.188	0.679	0.564	MH-2124
520	MR	MR	0.273	11,909	0.114	0.188	0.678	0.564	MH-2126
521	MR	MR	0.637	27,769	0.265	0.188	0.829	0.564	MH-2126
522	MR	MR	0.717	31,230	0.299	0.188	0.863	0.564	MH-2134
523	MR	MR	0.531	23,117	0.221	0.188	0.785	0.564	MH-2134
524	MR	MR	0.166	7,219	0.069	0.188	0.633	0.564	MH-2138
525	MR	MR	0.123	5,360	0.051	0.188	0.615	0.564	MH-2136
526	MR	MR	0.114	4,986	0.048	0.188	0.612	0.564	MH-2142
527	MR	MR	0.120	5,236	0.050	0.188	0.614	0.564	MH-2142
528	MR	MR	0.115	5,020	0.048	0.188	0.612	0.564	MH-2142
529	MR	MR	0.125	5,455	0.052	0.188	0.616	0.564	MH-2142
530	MR	MR	0.145	6,324	0.060	0.188	0.624	0.564	MH-2142
531	MR	MR	0.222	9,655	0.093	0.188	0.657	0.564	MH-2142
532	MR	MR	0.203	8,855	0.085	0.188	0.649	0.564	MH-2170
533	MR	MR	0.204	8,885	0.085	0.188	0.649	0.564	MH-2170
534	MR	MR	0.198	8,612	0.083	0.188	0.647	0.564	MH-2164
535	MR	MR	0.222	9,674	0.093	0.188	0.657	0.564	MH-2164
536	PQP	PQP	3.263	142,119	1.360	1.249	5.107	3.747	MH-2172
537	PQP	PQP	9.795	426,666	4.082	3.751	15.335	11.253	MH-2174
538	MR	MR	0.196	8,528	0.082	0.188	0.646	0.564	MH-1259
539	Vacant	MR	3.450	150,283	1.438	6.641	21.361	19.923	MH-30252
540	MR	MR	0.155	6,755	0.065	0.188	0.629	0.564	MH-1315
541	MR	MR	0.211	9,191	0.088	0.188	0.652	0.564	MH-1259
542	NC	NC	0.076	3,308	0.032	0.132	0.428	0.396	MH-1315
543	MR	MR	0.148	6,441	0.062	0.188	0.626	0.564	MH-1315
544	MR	MR	0.145	6,317	0.060	0.188	0.624	0.564	MH-1315
545	CBD	CBD	1.035	45,103	0.431	2.516	7.979	7.548	MH-1183
546	MR	MR	0.178	7,767	0.074	0.188	0.638	0.564	MH-1183
547	MR	MR	0.185	8,071	0.077	0.188	0.641	0.564	MH-1315
548	CBD	CBD	1.258	54,796	0.524	3.058	9.698	9.174	MH-30016
549	CBD	CBD	0.616	26,854	0.257	1.497	4.748	4.491	MH-1185
550	MR	MR	0.156	6,813	0.065	0.188	0.629	0.564	MH-1315
551	MR	MR	0.171	7,438	0.071	0.188	0.635	0.564	MH-1183
552	MR	MR	0.164	7,139	0.068	0.188	0.632	0.564	MH-1259
553	MR	MR	0.166	7,220	0.069	0.188	0.633	0.564	MH-2136
554	MR	MR	0.117	5,082	0.049	0.188	0.613	0.564	MH-2136
555	MR	MR	0.109	4,746	0.045	0.188	0.609	0.564	MH-2136
556	MR	MR	0.121	5,261	0.050	0.188	0.614	0.564	MH-2136
557	MR	MR	0.111	4,826	0.046	0.188	0.610	0.564	MH-2136
558	MR	MR	0.114	4,986	0.048	0.188	0.612	0.564	MH-2136
559	MR	MR	0.139	6,039	0.058	0.188	0.622	0.564	MH-2136
560	MR	MR	0.148	6,431	0.062	0.188	0.626	0.564	MH-1315
561	MR	MR	0.144	6,279	0.060	0.188	0.624	0.564	MH-1315
562	MR	MR	0.193	8,425	0.080	0.188	0.644	0.564	MH-2170
563	MR	MR	0.200	8,710	0.083	0.188	0.647	0.564	MH-2170
564	MR	MR	0.198	8,628	0.083	0.188	0.647	0.564	MH-2164
565	MR	MR	0.207	9,001	0.086	0.188	0.650	0.564	MH-2164
566	MR	MR	0.193	8,423	0.080	0.188	0.644	0.564	MH-1183
567	MR	MR	0.218	9,507	0.091	0.188	0.655	0.564	MH-2142
568	MR	MR	0.193	8,388	0.080	0.188	0.644	0.564	MH-1277
569	Vacant	PQP	0.431	18,775	0.180	0.347	1.221	1.041	MH-1159
570	MR	MR	0.156	6,814	0.065	0.188	0.629	0.564	MH-1277
571	CBD	CBD	0.360	15,702	0.150	0.875	2.775	2.625	MH-1187
572	MR	MR	0.127	5,533	0.053	0.188	0.617	0.564	MH-1315
573	Vacant	CBD	1.458	63,505	0.608	3.544	11.240	10.632	MH-1185
574	MR	MR	0.176	7,666	0.073	0.188	0.637	0.564	MH-1183
575	MR	MR	0.152	6,635	0.063	0.188	0.627	0.564	MH-1315
576	MR	MR	0.150	6,520	0.063	0.188	0.627	0.564	MH-1259
577	MR	MR	0.143	6,237	0.060	0.188	0.624	0.564	MH-1315
578	MR	MR	0.148	6,441	0.062	0.188	0.626	0.564	MH-1315
579	MR	MR	0.168	7,331	0.070	0.188	0.634	0.564	MH-1183
580	MR	MR	0.148	6,427	0.062	0.188	0.626	0.564	MH-1277
581	Vacant	CBD	1.024	44,610	0.427	2.489	7.894	7.467	MH-1185
582	MR	MR	0.161	7,028	0.067	0.188	0.631	0.564	MH-1315
583	MR	MR	0.126	5,489	0.053	0.188	0.617	0.564	MH-1277
584	MR	MR	0.185	8,037	0.077	0.188	0.641	0.564	MH-1183
585	MR	MR	0.165	7,171	0.069	0.188	0.633	0.564	MH-2142
586	Vacant	MR	0.378	16,455	0.158	0.728	2.342	2.184	MH-2134
587	MR	MR	0.237	10,330	0.099	0.188	0.663	0.564	MH-2164
588	MR	MR	0.150	6,545	0.063	0.188	0.627	0.564	MH-2170
589	MR	MR	0.188	8,208	0.078	0.188	0.642	0.564	MH-2164

Parcel ID	Existing Land Use	Buildout Land Use	Area (acres)	Area (ft^2)	I/I (gpm)	Buildout ADWF (gpm)	Buildout PWWF (gpm)	Buildout PDWF (gpm)	Manhole
590	Vacant	CBD	0.606	26,407	0.253	1.473	4.672	4.419	MH-30016
591	MR	MR	0.148	6,466	0.062	0.188	0.626	0.564	MH-1259
592	MR	MR	0.190	8,282	0.079	0.188	0.643	0.564	MH-2124
593	Vacant	PQP	1.605	69,904	0.669	27.778	84.003	83.334	MH-1159
594	MR	MR	0.196	8,518	0.082	0.188	0.646	0.564	MH-2142
595	MR	MR	0.160	6,951	0.067	0.188	0.631	0.564	MH-1315
596	MR	MR	0.143	6,237	0.060	0.188	0.624	0.564	MH-1315
597	MR	MR	0.108	4,688	0.045	0.188	0.609	0.564	MH-1315
598	MR	MR	0.146	6,345	0.061	0.188	0.625	0.564	MH-1259
599	CBD	CBD	0.299	13,044	0.125	0.727	2.306	2.181	MH-2124
600	MR	MR	0.156	6,815	0.065	0.188	0.629	0.564	MH-1183
601	PR	PR	1.947	84,813	0.811	0.270	1.081	0.270	MH-1277
602	MR	MR	0.159	6,915	0.066	0.188	0.630	0.564	MH-1277
603	MR	MR	0.144	6,288	0.060	0.188	0.624	0.564	MH-1277
604	MR	MR	0.147	6,412	0.061	0.188	0.625	0.564	MH-2136
605	MR	MR	0.133	5,782	0.055	0.188	0.619	0.564	MH-2136
606	MR	MR	0.126	5,500	0.053	0.188	0.617	0.564	MH-2136
607	MR	MR	0.118	5,121	0.049	0.188	0.613	0.564	MH-2136
608	MR	MR	0.132	5,771	0.055	0.188	0.619	0.564	MH-2136
609	MR	MR	0.122	5,311	0.051	0.188	0.615	0.564	MH-2136
610	MR	MR	0.122	5,329	0.051	0.188	0.615	0.564	MH-2136
611	MR	MR	0.130	5,650	0.054	0.188	0.618	0.564	MH-2136
612	MR	MR	0.118	5,147	0.049	0.188	0.613	0.564	MH-2136
613	MR	MR	0.126	5,469	0.053	0.188	0.617	0.564	MH-1315
614	MR	MR	0.236	10,265	0.098	0.188	0.662	0.564	MH-2170
615	MR	MR	0.274	11,920	0.114	0.188	0.678	0.564	MH-2142
616	MR	MR	0.140	6,091	0.058	0.188	0.622	0.564	MH-1259
617	MR	MR	0.105	4,573	0.044	0.188	0.608	0.564	MH-1315
618	MR	MR	0.146	6,359	0.061	0.188	0.625	0.564	MH-1183
619	MR	MR	0.204	8,901	0.085	0.188	0.649	0.564	MH-2164
620	MR	MR	0.153	6,656	0.064	0.188	0.628	0.564	MH-1315
621	MR	MR	0.104	4,533	0.043	0.188	0.607	0.564	MH-1315
622	MR	MR	0.154	6,723	0.064	0.188	0.628	0.564	MH-1259
623	MR	MR	0.141	6,154	0.059	0.188	0.623	0.564	MH-1259
624	MR	MR	0.219	9,540	0.091	0.188	0.655	0.564	MH-2142
625	MR	MR	0.192	8,378	0.080	0.188	0.644	0.564	MH-2124
626	MR	MR	0.244	10,632	0.102	0.188	0.666	0.564	MH-2164
627	MR	MR	0.168	7,333	0.070	0.188	0.634	0.564	MH-1315
628	MR	MR	0.150	6,551	0.063	0.188	0.627	0.564	MH-30002
629	MR	MR	0.147	6,425	0.061	0.188	0.625	0.564	MH-1357
630	MR	MR	0.122	5,317	0.051	0.188	0.615	0.564	MH-1277
631	CBD	CBD	1.137	49,506	0.474	2.764	8.766	8.292	MH-30016
632	MR	MR	0.144	6,269	0.060	0.188	0.624	0.564	MH-1259
633	MR	MR	0.099	4,326	0.041	0.188	0.605	0.564	MH-1315
634	MR	MR	0.212	9,229	0.088	0.188	0.652	0.564	MH-1183
635	Vacant	CBD	2.433	105,969	1.014	5.914	18.756	17.742	MH-1187
636	MR	MR	0.144	6,252	0.060	0.188	0.624	0.564	MH-30002
637	PQP	PQP	17.418	758,722	7.258	3.125	16.633	9.375	MH-2120
638	MR	MR	0.205	8,946	0.085	0.188	0.649	0.564	MH-1259
639	MR	MR	0.153	6,680	0.064	0.188	0.628	0.564	MH-1279
640	MR	MR	0.141	6,147	0.059	0.188	0.623	0.564	MH-1259
641	MR	MR	0.162	7,052	0.068	0.188	0.632	0.564	MH-1277
642	MR	MR	0.152	6,601	0.063	0.188	0.627	0.564	MH-30002
643	MR	MR	0.146	6,371	0.061	0.188	0.625	0.564	MH-1357
644	PQP	PQP	4.011	174,730	1.671	0.000	1.671	0.000	MH-30252
645	MR	MR	0.083	3,615	0.035	0.188	0.599	0.564	MH-1315
646	MR	MR	0.138	6,028	0.058	0.188	0.622	0.564	MH-1259
647	Vacant	CBD	1.916	83,481	0.798	4.657	14.769	13.971	MH-2120
648	MR	MR	0.220	9,597	0.092	0.188	0.656	0.564	MH-1259
649	Vacant	MR	2.728	118,843	1.137	5.251	16.890	15.753	MH-2142
650	PR	PR	1.413	61,553	0.589	0.196	0.785	0.196	MH-2164
651	MR	MR	0.130	5,664	0.054	0.188	0.618	0.564	MH-30000
652	MR	MR	0.139	6,069	0.058	0.188	0.622	0.564	MH-1259
653	MR	MR	0.154	6,693	0.064	0.188	0.628	0.564	MH-1279
654	MR	MR	0.101	4,402	0.042	0.188	0.606	0.564	MH-1315
655	MR	MR	0.160	6,969	0.067	0.188	0.631	0.564	MH-1259
656	MR	MR	0.141	6,124	0.059	0.188	0.623	0.564	MH-1259
657	MR	MR	0.148	6,434	0.062	0.188	0.626	0.564	MH-1357
658	MR	MR	0.079	3,449	0.033	0.188	0.597	0.564	MH-1277
659	MR	MR	0.147	6,415	0.061	0.188	0.625	0.564	MH-30000
660	HR	HR	3.465	150,919	1.444	6.569	21.151	19.707	MH-1183
661	MR	MR	0.208	9,065	0.087	0.188	0.651	0.564	MH-1259
662	MR	MR	0.094	4,107	0.039	0.188	0.603	0.564	MH-1277
663	MR	MR	0.149	6,508	0.062	0.188	0.626	0.564	MH-1279
664	MR	MR	0.146	6,342	0.061	0.188	0.625	0.564	MH-1357
665	MR	MR	0.148	6,465	0.062	0.188	0.626	0.564	MH-1279
666	MR	MR	0.180	7,829	0.075	0.188	0.639	0.564	MH-1279
667	MR	MR	0.176	7,649	0.073	0.188	0.637	0.564	MH-1259
668	MR	MR	0.148	6,431	0.062	0.188	0.626	0.564	MH-1357
669	MR	MR	0.140	6,095	0.058	0.188	0.622	0.564	MH-1279
670	MR	MR	0.150	6,529	0.063	0.188	0.627	0.564	MH-1259
671	PQP	PQP	1.047	45,592	0.436	2.545	8.071	7.635	MH-1205
672	MR	MR	0.152	6,610	0.063	0.188	0.627	0.564	MH-1279
673	MR	MR	0.124	5,409	0.052	0.188	0.616	0.564	MH-1357
674	MR	MR	0.192	8,345	0.080	0.188	0.644	0.564	MH-1285
675	MR	MR	0.152	6,610	0.063	0.188	0.627	0.564	MH-1279
676	MR	MR	0.150	6,524	0.063	0.188	0.627	0.564	MH-1259
677	MR	MR	0.146	6,345	0.061	0.188	0.625	0.564	MH-1259
678	MR	MR	0.131	5,725	0.055	0.188	0.619	0.564	MH-1279
679	MR	MR	0.152	6,622	0.063	0.188	0.627	0.564	MH-1259
680	MR	MR	0.150	6,555	0.063	0.188	0.627	0.564	MH-1279
681	PQP	PQP	0.406	17,675	0.169	0.987	3.130	2.961	MH-1189
682	MR	MR	0.117	5,104	0.049	0.188	0.613	0.564	MH-1279
683	MR	MR	0.147	6,403	0.061	0.188	0.625	0.564	MH-1259
684	MR	MR	0.172	7,479	0.072	0.188	0.636	0.564	MH-1259
685	MR	MR	0.134	5,817	0.056	0.188	0.620	0.564	MH-1279
686	MR	MR	0.150	6,517	0.063	0.188	0.627	0.564	MH-1259
687	MR	MR	0.152	6,607	0.063	0.188	0.627	0.564	MH-1259
688	MR	MR	0.101	4,406	0.042	0.188	0.606	0.564	MH-1279
689	MR	MR	0.164	7,166	0.068	0.188	0.632	0.564	MH-1259
690	MR	MR	0.128	5,593	0.053	0.188	0.617	0.564	MH-1279
691	Vacant	HR	1.884	82,076	0.785	7.065	21.980	21.195	MH-1207
692	MR	MR	0.168	7,338	0.070	0.188	0.634	0.564	MH-1259
693	MR	MR	0.110	4,784	0.046	0.188	0.610	0.564	MH-1259
694	CBD	CBD	0.226	9,864	0.094	0.549	1.741	1.647	MH-1193
695	MR	MR	0.162	7,067	0.068	0.188	0.632	0.564	MH-1279
696	MR	MR	0.150	6,540	0.063	0.188	0.627	0.564	MH-1259
697	MR	MR	0.131	5,712	0.055	0.188	0.619	0.564	MH-1279
698	MR	MR	0.160	6,977	0.067	0.188	0.631	0.564	MH-1279
699	MR	MR	0.156	6,813	0.065	0.188	0.629	0.564	MH-1279
700	CBD	CBD	0.389	16,957	0.162	0.945	2.997	2.835	MH-1205
701	CBD	CBD	0.227	9,902	0.095	0.552	1.751	1.656	MH-1193
702	MR	MR	0.151	6,579	0.063	0.188	0.627	0.564	MH-1249
703	MR	MR	0.099	4,324	0.041	0.188	0.605	0.564	MH-1259
704	MR	MR	0.103	4,466	0.043	0.188	0.607	0.564	MH-1279
705	MR	MR	0.166	7,230	0.069	0.188	0.633	0.564	MH-1285
706	MR	MR	0.111	4,825	0.046	0.188	0.610	0.564	MH-1279
707	CBD	CBD	1.515	65,985	0.631	3.682	11.677	11.046	MH-1193

Parcel ID	Existing Land Use	Buildout Land Use	Area (acres)	Area (ft^2)	I/I (gpm)	Buildout ADWF (gpm)	Buildout PWWF (gpm)	Buildout PDWF (gpm)	Manhole
708	MR	MR	0.149	6,484	0.062	0.188	0.626	0.564	MH-1249
709	MR	MR	0.200	8,716	0.083	0.188	0.647	0.564	MH-1279
710	MR	MR	0.171	7,449	0.071	0.188	0.635	0.564	MH-1153
711	MR	MR	0.226	9,855	0.094	0.188	0.658	0.564	MH-1089
712	MR	MR	0.596	25,971	0.248	0.188	0.812	0.564	MH-1153
713	MR	MR	0.172	7,484	0.072	0.188	0.636	0.564	MH-1089
714	MR	MR	0.144	6,252	0.060	0.188	0.624	0.564	MH-1089
715	CBD	CBD	0.413	17,982	0.172	1.004	3.184	3.012	MH-1157
716	MR	MR	0.199	8,676	0.083	0.188	0.647	0.564	MH-1089
717	MR	MR	0.146	6,353	0.061	0.188	0.625	0.564	MH-1259
718	MR	MR	0.211	9,205	0.088	0.188	0.652	0.564	MH-1089
719	Vacant	MR	0.204	8,873	0.085	0.393	1.264	1.179	MH-2298
720	Vacant	MR	0.207	9,005	0.086	0.398	1.280	1.194	MH-2298
721	Vacant	MR	0.213	9,274	0.089	0.410	1.319	1.230	MH-2298
722	Vacant	MR	0.271	11,795	0.113	0.522	1.679	1.566	MH-2298
723	Vacant	MR	0.142	6,164	0.059	0.273	0.878	0.819	MH-2298
724	MR	MR	0.161	7,021	0.067	0.188	0.631	0.564	MH-1279
725	Vacant	MR	0.242	10,550	0.101	0.466	1.499	1.398	MH-2298
726	MR	MR	0.148	6,434	0.062	0.188	0.626	0.564	MH-1249
727	MR	MR	0.142	6,198	0.059	0.188	0.623	0.564	MH-1259
728	MR	MR	0.108	4,699	0.045	0.188	0.609	0.564	MH-1279
729	MR	MR	0.140	6,104	0.058	0.188	0.622	0.564	MH-1279
730	MR	MR	0.514	22,411	0.214	0.188	0.778	0.564	MH-2060
731	MR	MR	0.094	4,078	0.039	0.188	0.603	0.564	MH-1279
732	MR	MR	0.211	9,209	0.088	0.188	0.652	0.564	MH-1169
733	CBD	CBD	0.259	11,265	0.108	0.630	1.998	1.890	MH-1205
734	MR	MR	0.153	6,654	0.064	0.188	0.628	0.564	MH-1279
735	MR	MR	0.211	9,191	0.088	0.188	0.652	0.564	MH-1153
736	Vacant	MR	0.146	6,373	0.061	0.281	0.904	0.843	MH-2298
737	Vacant	MR	0.150	6,516	0.063	0.289	0.930	0.867	MH-2298
738	Vacant	MR	0.146	6,375	0.061	0.281	0.904	0.843	MH-2298
739	MR	MR	0.119	5,171	0.050	0.188	0.614	0.564	MH-1279
740	CBD	CBD	0.209	9,088	0.087	0.508	1.611	1.524	MH-1157
741	MR	MR	0.150	6,551	0.063	0.188	0.627	0.564	MH-1259
742	MR	MR	0.185	8,075	0.077	0.188	0.641	0.564	MH-1259
743	CBD	CBD	0.267	11,611	0.111	0.649	2.058	1.947	MH-1205
744	MR	MR	0.128	5,595	0.053	0.188	0.617	0.564	MH-1089
745	MR	MR	0.240	10,440	0.100	0.188	0.664	0.564	MH-1279
746	MR	MR	0.165	7,202	0.069	0.188	0.633	0.564	MH-1259
747	MR	MR	0.645	28,076	0.269	0.188	0.833	0.564	MH-1153
748	MR	MR	0.131	5,712	0.055	0.188	0.619	0.564	MH-1279
749	MR	MR	0.095	4,150	0.040	0.188	0.604	0.564	MH-1279
750	Vacant	MR	0.137	5,958	0.057	0.264	0.849	0.792	MH-2298
751	CBD	CBD	0.266	11,581	0.111	0.647	2.052	1.941	MH-1157
752	MR	MR	0.168	7,310	0.070	0.188	0.634	0.564	MH-1259
753	MR	MR	0.140	6,080	0.058	0.188	0.622	0.564	MH-1259
754	MR	MR	0.146	6,371	0.061	0.188	0.625	0.564	MH-1259
755	CBD	CBD	0.186	8,118	0.078	0.452	1.434	1.356	MH-1205
756	MR	MR	0.154	6,710	0.064	0.188	0.628	0.564	MH-1279
757	CBD	CBD	1.025	44,656	0.427	2.491	7.900	7.473	MH-1199
758	MR	MR	0.114	4,952	0.048	0.188	0.612	0.564	MH-1279
759	HR	HR	1.900	82,780	0.792	3.602	11.598	10.806	MH-1183
760	CBD	CBD	0.256	11,153	0.107	0.622	1.973	1.866	MH-1207
761	MR	MR	0.111	4,847	0.046	0.188	0.610	0.564	MH-1279
762	Vacant	MR	0.139	6,049	0.058	0.268	0.862	0.804	MH-2298
763	MR	MR	0.185	8,039	0.077	0.188	0.641	0.564	MH-1259
764	MR	MR	0.175	7,619	0.073	0.188	0.637	0.564	MH-1259
765	MR	MR	0.182	7,929	0.076	0.188	0.640	0.564	MH-1089
766	Vacant	MR	0.157	6,841	0.065	0.302	0.971	0.906	MH-2298
767	MR	MR	0.221	9,647	0.092	0.188	0.656	0.564	MH-1259
768	CBD	CBD	0.240	10,462	0.100	0.583	1.849	1.749	MH-1205
769	MR	MR	0.301	13,119	0.125	0.188	0.689	0.564	MH-2062
770	CBD	CBD	0.114	4,956	0.048	0.277	0.879	0.831	MH-1205
771	Vacant	MR	0.137	5,951	0.057	0.264	0.849	0.792	MH-2298
772	MR	MR	0.126	5,505	0.053	0.188	0.617	0.564	MH-1259
773	MR	MR	0.205	8,913	0.085	0.188	0.649	0.564	MH-1089
774	MR	MR	0.151	6,579	0.063	0.188	0.627	0.564	MH-1249
775	MR	MR	0.117	5,088	0.049	0.188	0.613	0.564	MH-1279
776	MR	MR	0.146	6,343	0.061	0.188	0.625	0.564	MH-1259
777	MR	MR	0.114	4,971	0.048	0.188	0.612	0.564	MH-1279
778	CBD	CBD	0.094	4,084	0.039	0.228	0.723	0.684	MH-1205
779	MR	MR	0.106	4,624	0.044	0.188	0.608	0.564	MH-1279
780	MR	MR	0.203	8,832	0.085	0.188	0.649	0.564	MH-1089
781	MR	MR	0.179	7,819	0.075	0.188	0.639	0.564	MH-1089
782	CBD	CBD	0.254	11,046	0.106	0.617	1.957	1.851	MH-1207
783	MR	MR	0.221	9,613	0.092	0.188	0.656	0.564	MH-1089
784	MR	MR	0.145	6,314	0.060	0.188	0.624	0.564	MH-1259
785	CBD	CBD	0.105	4,564	0.044	0.255	0.809	0.765	MH-1205
786	MR	MR	0.201	8,742	0.084	0.188	0.648	0.564	MH-1259
787	MR	MR	0.160	6,962	0.067	0.188	0.631	0.564	MH-1089
788	Vacant	MR	0.152	6,642	0.063	0.293	0.942	0.879	MH-2298
789	Vacant	MR	0.134	5,831	0.056	0.258	0.830	0.774	MH-2298
790	Vacant	MR	0.134	5,827	0.056	0.258	0.830	0.774	MH-2298
791	Vacant	MR	0.134	5,824	0.056	0.258	0.830	0.774	MH-2298
792	Vacant	MR	0.143	6,232	0.060	0.275	0.885	0.825	MH-2298
793	MR	MR	0.442	19,238	0.184	0.188	0.748	0.564	MH-1153
794	CBD	CBD	0.233	10,151	0.097	0.566	1.795	1.698	MH-1155
795	Vacant	CBD	0.993	43,269	0.414	2.414	7.656	7.242	MH-1207
796	CBD	CBD	0.186	8,115	0.078	0.452	1.434	1.356	MH-1205
797	MR	MR	0.417	18,173	0.174	0.188	0.738	0.564	MH-2062
798	MR	MR	0.107	4,650	0.045	0.188	0.609	0.564	MH-1285
799	MR	MR	0.112	4,894	0.047	0.188	0.611	0.564	MH-1279
800	MR	MR	0.143	6,211	0.060	0.188	0.624	0.564	MH-1259
801	Vacant	MR	0.153	6,668	0.064	0.295	0.949	0.885	MH-2298
802	Vacant	MR	0.140	6,097	0.058	0.269	0.865	0.807	MH-2298
803	Vacant	MR	0.138	6,000	0.058	0.266	0.856	0.798	MH-2298
804	MR	MR	0.183	7,961	0.076	0.188	0.640	0.564	MH-2060
805	MR	MR	0.164	7,139	0.068	0.188	0.632	0.564	MH-1259
806	MR	MR	0.149	6,503	0.062	0.188	0.626	0.564	MH-2094
807	MR	MR	0.146	6,339	0.061	0.188	0.625	0.564	MH-2094
808	MR	MR	0.146	6,376	0.061	0.188	0.625	0.564	MH-2094
809	MR	MR	0.139	6,035	0.058	0.188	0.622	0.564	MH-2094
810	MR	MR	0.161	7,026	0.067	0.188	0.631	0.564	MH-2094
811	MR	MR	0.154	6,707	0.064	0.188	0.628	0.564	MH-1249
812	CBD	CBD	0.192	8,359	0.080	0.467	1.481	1.401	MH-1205
813	MR	MR	0.146	6,374	0.061	0.188	0.625	0.564	MH-1089
814	MR	MR	0.143	6,240	0.060	0.188	0.624	0.564	MH-1259
815	MR	MR	0.885	38,570	0.369	0.188	0.933	0.564	MH-1249
816	Vacant	CBD	0.251	10,951	0.105	0.610	1.935	1.830	MH-1207
817	CBD	CBD	0.247	10,750	0.103	0.600	1.903	1.800	MH-1161
818	CBD	CBD	0.158	6,871	0.066	0.384	1.218	1.152	MH-1207
819	MR	MR	0.177	7,717	0.074	0.188	0.638	0.564	MH-1259
820	MR	MR	0.151	6,561	0.063	0.188	0.627	0.564	MH-1279
821	MR	MR	0.061	2,648	0.025	0.188	0.589	0.564	MH-1089
822	MR	MR	0.149	6,478	0.062	0.188	0.626	0.564	MH-1089
823	CBD	CBD	0.144	6,285	0.060	0.350	1.110	1.050	MH-1207
824	MR	MR	0.144	6,293	0.060	0.188	0.624	0.564	MH-1259
825	MHR	MHR	0.265	11,533	0.110	0.188	0.674	0.564	MH-1169

Attributes of parcel_loading_to_manhole.shp

Parcel ID	Existing Land Use	Buildout Land Use	Area (acres)	Area (ft^2)	I/I (gpm)	Buildout ADWF (gpm)	Buildout PWWF (gpm)	Buildout PDWF (gpm)	Manhole
826	CBD	CBD	1.160	50,525	0.483	2.819	8.940	8.457	MH-1207
827	Vacant	MR	0.133	5,811	0.055	0.256	0.823	0.768	MH-2298
828	MR	MR	0.155	6,756	0.065	0.188	0.629	0.564	MH-1259
829	Vacant	MR	0.150	6,537	0.063	0.289	0.930	0.867	MH-2298
830	Vacant	MR	0.143	6,243	0.060	0.275	0.885	0.825	MH-2298
831	MR	MR	0.196	8,539	0.082	0.188	0.646	0.564	MH-2060
832	Vacant	MR	0.138	6,021	0.058	0.266	0.856	0.798	MH-2298
833	MR	MR	0.145	6,312	0.060	0.188	0.624	0.564	MH-1089
834	CBD	CBD	0.246	10,720	0.103	0.598	1.897	1.794	MH-1161
835	MR	MR	0.454	19,787	0.189	0.188	0.753	0.564	MH-1153
836	MR	MR	0.153	6,657	0.064	0.188	0.628	0.564	MH-1249
837	MR	MR	0.106	4,613	0.044	0.188	0.608	0.564	MH-1259
838	MR	MR	0.209	9,084	0.087	0.188	0.651	0.564	MH-1089
839	MR	MR	0.177	7,728	0.074	0.188	0.638	0.564	MH-1089
840	MR	MR	0.160	6,984	0.067	0.188	0.631	0.564	MH-1089
841	MR	MR	0.335	14,572	0.140	0.188	0.704	0.564	MH-1089
842	Vacant	MR	0.217	9,464	0.090	0.418	1.344	1.254	MH-2298
843	Vacant	MR	0.169	7,375	0.070	0.325	1.045	0.975	MH-2298
844	Vacant	MR	0.144	6,271	0.060	0.277	0.891	0.831	MH-2298
845	Vacant	MR	0.144	6,282	0.060	0.277	0.891	0.831	MH-2298
846	Vacant	MR	0.144	6,282	0.060	0.277	0.891	0.831	MH-2298
847	Vacant	MR	0.144	6,282	0.060	0.277	0.891	0.831	MH-2298
848	MR	MR	0.159	6,931	0.066	0.188	0.630	0.564	MH-1089
849	CBD	CBD	0.104	4,530	0.043	0.253	0.802	0.759	MH-1207
850	Vacant	MR	0.135	5,873	0.056	0.260	0.836	0.780	MH-2298
851	Vacant	MR	0.135	5,869	0.056	0.260	0.836	0.780	MH-2298
852	Vacant	MR	0.145	6,296	0.060	0.279	0.897	0.837	MH-2298
853	Vacant	MR	0.135	5,876	0.056	0.260	0.836	0.780	MH-2298
854	CBD	CBD	0.078	3,416	0.033	0.190	0.603	0.570	MH-1199
855	MR	MR	0.170	7,401	0.071	0.188	0.635	0.564	MH-1259
856	MR	MR	0.807	35,159	0.336	0.188	0.900	0.564	MH-2062
857	MR	MR	0.144	6,269	0.060	0.188	0.624	0.564	MH-1089
858	CBD	CBD	0.169	7,381	0.070	0.411	1.303	1.233	MH-1161
859	MR	MR	0.142	6,191	0.059	0.188	0.623	0.564	MH-1259
860	CBD	CBD	0.201	8,772	0.084	0.489	1.551	1.467	MH-1207
861	MHR	MHR	0.094	4,109	0.039	0.188	0.603	0.564	MH-1169
862	MR	MR	0.100	4,352	0.042	0.188	0.606	0.564	MH-1259
863	MR	MR	0.185	8,065	0.077	0.188	0.641	0.564	MH-1259
864	MR	MR	0.169	7,378	0.070	0.188	0.634	0.564	MH-2094
865	Vacant	MR	0.155	6,745	0.065	0.298	0.959	0.894	MH-2298
866	MR	MR	0.143	6,246	0.060	0.188	0.624	0.564	MH-2094
867	CBD	CBD	0.177	7,715	0.074	0.430	1.364	1.290	MH-1161
868	MR	MR	0.138	6,026	0.058	0.188	0.622	0.564	MH-2094
869	MR	MR	0.150	6,514	0.063	0.188	0.627	0.564	MH-2094
870	MR	MR	0.144	6,252	0.060	0.188	0.624	0.564	MH-2094
871	CBD	CBD	0.270	11,754	0.113	0.656	2.081	1.968	MH-1199
872	MR	MR	0.146	6,366	0.061	0.188	0.625	0.564	MH-2094
873	MR	MR	0.138	6,027	0.058	0.188	0.622	0.564	MH-2094
874	Vacant	MR	0.160	6,987	0.067	0.308	0.991	0.924	MH-2298
875	MR	MR	0.158	6,894	0.066	0.188	0.630	0.564	MH-2094
876	Vacant	MR	0.152	6,635	0.063	0.293	0.942	0.879	MH-2298
877	Vacant	MR	0.147	6,394	0.061	0.283	0.910	0.849	MH-2298
878	MR	MR	0.109	4,732	0.045	0.188	0.609	0.564	MH-1249
879	MR	MR	0.208	9,060	0.087	0.188	0.651	0.564	MH-2062
880	CBD	CBD	0.199	8,655	0.083	0.484	1.535	1.452	MH-1207
881	MHR	MHR	0.112	4,892	0.047	0.188	0.611	0.564	MH-1169
882	MHR	MHR	0.187	8,166	0.078	0.188	0.642	0.564	MH-1169
883	CBD	CBD	0.487	21,197	0.203	1.184	3.755	3.552	MH-1207
884	MR	MR	0.495	21,546	0.206	0.188	0.770	0.564	MH-1153
885	Vacant	MR	0.472	20,556	0.197	0.909	2.924	2.727	MH-1209
886	MR	MR	0.141	6,156	0.059	0.188	0.623	0.564	MH-1259
887	MR	MR	0.177	7,711	0.074	0.188	0.638	0.564	MH-1259
888	MR	MR	0.158	6,867	0.066	0.188	0.630	0.564	MH-1089
889	CBD	CBD	0.742	32,301	0.309	1.803	5.718	5.409	MH-1215
890	MR	MR	0.104	4,533	0.043	0.188	0.607	0.564	MH-1249
891	MR	MR	0.174	7,561	0.073	0.188	0.637	0.564	MH-1259
892	Vacant	MR	0.150	6,518	0.063	0.289	0.930	0.867	MH-2298
893	MHR	MHR	0.147	6,418	0.061	0.188	0.625	0.564	MH-1169
894	CBD	CBD	0.141	6,123	0.059	0.343	1.088	1.029	MH-1207
895	CBD	CBD	0.384	16,742	0.160	0.933	2.959	2.799	MH-1207
896	HR	HR	0.217	9,455	0.090	0.411	1.323	1.233	MH-1161
897	CBD	CBD	0.155	6,750	0.065	0.377	1.196	1.131	MH-1161
898	MR	MR	0.462	20,123	0.193	0.188	0.757	0.564	MH-2062
899	MHR	MHR	0.164	7,141	0.068	0.188	0.632	0.564	MH-1169
900	MR	MR	0.144	6,293	0.060	0.188	0.624	0.564	MH-1249
901	MR	MR	0.158	6,879	0.066	0.188	0.630	0.564	MH-1089
902	MR	MR	0.143	6,237	0.060	0.188	0.624	0.564	MH-1259
903	MHR	MHR	0.181	7,891	0.075	0.188	0.639	0.564	MH-1175
904	MHR	MHR	0.080	3,486	0.033	0.188	0.597	0.564	MH-1169
905	MR	MR	0.149	6,501	0.062	0.188	0.626	0.564	MH-1089
906	CBD	CBD	0.279	12,140	0.116	0.678	2.150	2.034	MH-1207
907	MR	MR	0.136	5,909	0.057	0.188	0.621	0.564	MH-1089
908	MR	MR	0.439	19,137	0.183	0.188	0.747	0.564	MH-1209
909	MR	MR	0.155	6,749	0.065	0.188	0.629	0.564	MH-1249
910	MR	MR	0.151	6,587	0.063	0.188	0.627	0.564	MH-2094
911	CBD	CBD	0.861	37,488	0.359	2.093	6.638	6.279	MH-1201
912	MR	MR	0.317	13,790	0.132	0.188	0.696	0.564	MH-2062
913	MR	MR	0.550	23,976	0.229	0.188	0.793	0.564	MH-1153
914	MHR	MHR	0.124	5,386	0.052	0.188	0.616	0.564	MH-1175
915	MR	MR	0.162	7,053	0.068	0.188	0.632	0.564	MH-1249
916	MR	MR	0.160	6,987	0.067	0.188	0.631	0.564	MH-1089
917	Vacant	MR	0.154	6,710	0.064	0.296	0.952	0.888	MH-2298
918	MR	MR	0.295	12,833	0.123	0.188	0.687	0.564	MH-2094
919	MR	MR	0.162	7,041	0.068	0.188	0.632	0.564	MH-1089
920	MHR	MHR	0.083	3,634	0.035	0.188	0.599	0.564	MH-1169
921	HR	HR	0.158	6,891	0.066	0.300	0.966	0.900	MH-1149
922	Vacant	MR	0.178	7,743	0.074	0.343	1.103	1.029	MH-2298
923	Vacant	MR	0.146	6,359	0.061	0.281	0.904	0.843	MH-2298
924	Vacant	MR	0.146	6,359	0.061	0.281	0.904	0.843	MH-2298
925	Vacant	MR	0.155	6,765	0.065	0.298	0.959	0.894	MH-2298
926	Vacant	MR	0.149	6,509	0.062	0.287	0.923	0.861	MH-2298
927	Vacant	MR	0.142	6,177	0.059	0.273	0.878	0.819	MH-2298
928	MR	MR	0.210	9,145	0.088	0.188	0.652	0.564	MH-2062
929	CBD	CBD	0.153	6,683	0.064	0.372	1.180	1.116	MH-1215
930	MHR	MHR	0.134	5,820	0.056	0.188	0.620	0.564	MH-1171
931	MR	MR	0.145	6,333	0.060	0.188	0.624	0.564	MH-1249
932	MR	MR	0.244	10,621	0.102	0.188	0.666	0.564	MH-1259
933	MR	MR	0.156	6,795	0.065	0.188	0.629	0.564	MH-1089
934	Vacant	MR	0.145	6,323	0.060	0.279	0.897	0.837	MH-2298
935	Vacant	MR	0.141	6,162	0.059	0.271	0.872	0.813	MH-2298
936	MR	MR	0.170	7,405	0.071	0.327	1.052	0.981	MH-2298
937	MR	MR	0.159	6,942	0.066	0.306	0.984	0.918	MH-2298
938	MR	MR	0.159	6,933	0.066	0.188	0.630	0.564	MH-1089
939	MHR	MHR	0.109	4,763	0.045	0.188	0.609	0.564	MH-1175
940	HR	HR	0.329	14,322	0.137	0.624	2.009	1.872	MH-1149
941	MHR	MHR	0.191	8,339	0.080	0.188	0.644	0.564	MH-1171
942	MR	MR	0.226	9,832	0.094	0.188	0.658	0.564	MH-1249
943	HR	HR	0.164	7,131	0.068	0.311	1.001	0.933	MH-1161

Parcel ID	Existing Land Use	Buildout Land Use	Area (acres)	Area (ft^2)	I/I (gpm)	Buildout ADWF (gpm)	Buildout PWWF (gpm)	Buildout PDWF (gpm)	Manhole
944	MR	MR	0.150	6,555	0.063	0.188	0.627	0.564	MH-1089
945	MR	MR	0.242	10,546	0.101	0.188	0.665	0.564	MH-2062
946	MR	MR	0.190	8,296	0.079	0.188	0.643	0.564	MH-1089
947	CBD	CBD	0.166	7,211	0.069	0.403	1.278	1.209	MH-1207
948	MR	MR	0.171	7,441	0.071	0.188	0.635	0.564	MH-2094
949	MR	MR	0.144	6,262	0.060	0.188	0.624	0.564	MH-2094
950	MHR	MHR	0.078	3,402	0.033	0.188	0.597	0.564	MH-1169
951	MR	MR	0.141	6,146	0.059	0.188	0.623	0.564	MH-2094
952	MHR	MHR	0.091	3,974	0.038	0.188	0.602	0.564	MH-1175
953	MR	MR	0.149	6,479	0.062	0.188	0.626	0.564	MH-2094
954	MR	MR	0.138	6,004	0.058	0.188	0.622	0.564	MH-2094
955	MR	MR	0.141	6,147	0.059	0.188	0.623	0.564	MH-2094
956	MR	MR	0.147	6,394	0.061	0.188	0.625	0.564	MH-2094
957	MR	MR	0.183	7,958	0.076	0.188	0.640	0.564	MH-2094
958	MR	MR	0.168	7,307	0.070	0.188	0.634	0.564	MH-2094
959	MHR	MHR	0.131	5,696	0.055	0.188	0.619	0.564	MH-1175
960	MR	MR	0.140	6,108	0.058	0.188	0.622	0.564	MH-2094
961	MR	MR	0.166	7,241	0.069	0.188	0.633	0.564	MH-1089
962	CBD	CBD	0.252	10,988	0.105	0.613	1.944	1.839	MH-1209
963	MHR	MHR	0.088	3,813	0.037	0.188	0.601	0.564	MH-1175
964	Vacant	MR	0.154	6,710	0.064	0.296	0.952	0.888	MH-2298
965	CBD	CBD	0.172	7,498	0.072	0.418	1.326	1.254	MH-1207
966	MR	MR	0.235	10,242	0.098	0.188	0.662	0.564	MH-1249
967	MHR	MHR	0.127	5,517	0.053	0.188	0.617	0.564	MH-1171
968	Vacant	HR	0.230	10,027	0.096	0.863	2.685	2.589	MH-1149
969	CBD	CBD	0.214	9,306	0.089	0.520	1.649	1.560	MH-1215
970	Vacant	MR	0.150	6,518	0.063	0.289	0.930	0.867	MH-2298
971	Vacant	MR	0.133	5,778	0.055	0.256	0.823	0.768	MH-2298
972	MR	MR	0.140	6,118	0.058	0.188	0.622	0.564	MH-1089
973	MHR	MHR	0.132	5,764	0.055	0.188	0.619	0.564	MH-1175
974	CBD	CBD	0.294	12,803	0.123	0.715	2.268	2.145	MH-1199
975	MR	MR	0.210	9,129	0.088	0.188	0.652	0.564	MH-1153
976	Vacant	MR	0.137	5,950	0.057	0.264	0.849	0.792	MH-2298
977	MR	MR	0.133	5,781	0.055	0.256	0.823	0.768	MH-2298
978	LR	LR	0.148	6,460	0.062	0.219	0.719	0.657	MH-1215
979	MR	MR	0.152	6,600	0.063	0.188	0.627	0.564	MH-1089
980	MR	MR	0.148	6,468	0.062	0.285	0.917	0.855	MH-2298
981	MR	MR	0.139	6,076	0.058	0.268	0.862	0.804	MH-2298
982	CBD	CBD	0.816	35,527	0.340	1.983	6.289	5.949	MH-1207
983	MHR	MHR	0.096	4,180	0.040	0.188	0.604	0.564	MH-1175
984	MR	MR	0.142	6,188	0.059	0.188	0.623	0.564	MH-1089
985	LR	LR	0.257	11,187	0.107	0.219	0.764	0.657	MH-1137
986	MR	MR	0.151	6,558	0.063	0.188	0.627	0.564	MH-2094
987	MR	MR	0.102	4,449	0.043	0.188	0.607	0.564	MH-1209
988	Vacant	MR	0.162	7,076	0.068	0.312	1.004	0.936	MH-2298
989	Vacant	MR	0.215	9,363	0.090	0.414	1.332	1.242	MH-2298
990	MR	MR	0.189	8,245	0.079	0.188	0.643	0.564	MH-1097
991	Vacant	MR	0.186	8,118	0.078	0.358	1.152	1.074	MH-2298
992	CBD	CBD	0.194	8,458	0.081	0.472	1.497	1.416	MH-1245
993	MR	MR	0.144	6,278	0.060	0.188	0.624	0.564	MH-1089
994	Vacant	MR	0.154	6,710	0.064	0.296	0.952	0.888	MH-2298
995	MR	MR	0.186	8,106	0.078	0.188	0.642	0.564	MH-1089
996	MR	MR	0.827	36,040	0.345	0.188	0.909	0.564	MH-2016
997	CBD	CBD	0.126	5,470	0.053	0.306	0.971	0.918	MH-1215
998	MHR	MHR	0.102	4,448	0.043	0.188	0.607	0.564	MH-1175
999	LR	LR	0.262	11,423	0.109	0.219	0.766	0.657	MH-1137
1000	Vacant	MR	0.121	5,278	0.050	0.233	0.749	0.699	MH-2298
1001	MR	MR	0.345	15,011	0.144	0.188	0.708	0.564	MH-1089
1002	MR	MR	0.196	8,539	0.082	0.188	0.646	0.564	MH-1097
1003	CBD	CBD	0.122	5,317	0.051	0.297	0.942	0.891	MH-1245
1004	Vacant	MR	0.152	6,601	0.063	0.293	0.942	0.879	MH-2298
1005	MR	MR	0.171	7,463	0.071	0.188	0.635	0.564	MH-2094
1006	MR	MR	0.199	8,652	0.083	0.188	0.647	0.564	MH-2094
1007	MR	MR	0.176	7,675	0.073	0.188	0.637	0.564	MH-2094
1008	MR	MR	0.176	7,671	0.073	0.188	0.637	0.564	MH-2094
1009	MR	MR	0.177	7,695	0.074	0.188	0.638	0.564	MH-2094
1010	MR	MR	0.142	6,180	0.059	0.188	0.623	0.564	MH-2094
1011	MR	MR	0.141	6,129	0.059	0.188	0.623	0.564	MH-2094
1012	MR	MR	0.162	7,047	0.068	0.188	0.632	0.564	MH-1089
1013	MR	MR	0.147	6,404	0.061	0.188	0.625	0.564	MH-2094
1014	MHR	MHR	0.092	3,997	0.038	0.188	0.602	0.564	MH-1171
1015	Vacant	MR	0.139	6,072	0.058	0.268	0.862	0.804	MH-2298
1016	MR	MR	0.137	5,963	0.057	0.188	0.621	0.564	MH-2094
1017	MR	MR	0.133	5,779	0.055	0.256	0.823	0.768	MH-2298
1018	HR	HR	0.178	7,737	0.074	0.337	1.085	1.011	MH-1149
1019	MR	MR	0.141	6,124	0.059	0.188	0.623	0.564	MH-2094
1020	MR	MR	0.354	15,424	0.148	0.188	0.712	0.564	MH-2062
1021	MR	MR	0.145	6,316	0.060	0.188	0.624	0.564	MH-2094
1022	MR	MR	0.105	4,588	0.044	0.188	0.608	0.564	MH-1209
1023	MR	MR	0.166	7,222	0.069	0.188	0.633	0.564	MH-2094
1024	MR	MR	0.149	6,473	0.062	0.287	0.923	0.861	MH-2298
1025	MR	MR	0.139	6,070	0.058	0.268	0.862	0.804	MH-2298
1026	CBD	CBD	0.132	5,765	0.055	0.321	1.018	0.963	MH-1215
1027	HR	HR	0.464	20,215	0.193	0.880	2.833	2.640	MH-1149
1028	CBD	CBD	0.282	12,304	0.118	0.685	2.173	2.055	MH-1245
1029	MR	MR	0.202	8,808	0.084	0.188	0.648	0.564	MH-2094
1030	MHR	MHR	0.131	5,701	0.055	0.188	0.619	0.564	MH-1175
1031	Vacant	MR	0.149	6,500	0.062	0.287	0.923	0.861	MH-2298
1032	Vacant	MR	0.256	11,149	0.107	0.493	1.586	1.479	MH-2298
1033	MHR	MHR	0.196	8,547	0.082	0.188	0.646	0.564	MH-1175
1034	MR	MR	0.170	7,388	0.071	0.188	0.635	0.564	MH-1097
1035	LR	LR	0.165	7,202	0.069	0.219	0.726	0.657	MH-1137
1036	MHR	MHR	0.137	5,974	0.057	0.188	0.621	0.564	MH-1175
1037	CBD	CBD	0.107	4,645	0.045	0.260	0.825	0.780	MH-1215
1038	MR	MR	0.156	6,797	0.065	0.188	0.629	0.564	MH-2094
1039	Vacant	MR	0.154	6,710	0.064	0.296	0.952	0.888	MH-2298
1040	MR	MR	0.212	9,220	0.088	0.188	0.652	0.564	MH-1209
1041	MHR	MHR	0.086	3,740	0.036	0.188	0.600	0.564	MH-1171
1042	CBD	CBD	0.089	3,870	0.037	0.216	0.685	0.648	MH-1201
1043	MHR	MHR	0.103	4,486	0.043	0.188	0.607	0.564	MH-1175
1044	MR	MR	0.151	6,587	0.063	0.188	0.627	0.564	MH-2016
1045	LR	LR	0.094	4,106	0.039	0.219	0.696	0.657	MH-1137
1046	Vacant	MR	0.136	5,930	0.057	0.262	0.843	0.786	MH-2298
1047	CBD	CBD	0.158	6,883	0.066	0.384	1.218	1.152	MH-1215
1048	Vacant	MR	0.155	6,760	0.065	0.298	0.959	0.894	MH-2298
1049	CBD	CBD	0.182	7,907	0.076	0.442	1.402	1.326	MH-1217
1050	CBD	CBD	0.948	41,316	0.395	2.304	7.307	6.912	MH-1245
1051	MHR	MHR	0.179	7,802	0.075	0.188	0.639	0.564	MH-1171
1052	LR	LR	0.151	6,560	0.063	0.219	0.720	0.657	MH-1137
1053	MR	MR	0.352	15,342	0.147	0.188	0.711	0.564	MH-2064
1054	MR	MR	0.155	6,773	0.065	0.188	0.629	0.564	MH-1089
1055	Vacant	MR	0.130	5,682	0.054	0.250	0.804	0.750	MH-2298
1056	MR	MR	0.160	6,986	0.067	0.188	0.631	0.564	MH-1089
1057	MR	MR	0.152	6,611	0.063	0.293	0.942	0.879	MH-2298
1058	MR	MR	0.153	6,675	0.064	0.295	0.949	0.885	MH-2298
1059	MR	MR	0.133	5,806	0.055	0.256	0.823	0.768	MH-2298
1060	MHR	MHR	0.071	3,092	0.030	0.188	0.594	0.564	MH-1175
1061	LR	LR	0.096	4,174	0.040	0.219	0.697	0.657	MH-1137

Attributes of parcel_loading_to_manhole.shp

Parcel ID	Existing Land Use	Buildout Land Use	Area (acres)	Area (ft^2)	I/I (gpm)	Buildout ADWF (gpm)	Buildout PWWF (gpm)	Buildout PDWF (gpm)	Manhole
1062	MHR	MHR	0.119	5,171	0.050	0.188	0.614	0.564	MH-1175
1063	CBD	CBD	0.155	6,746	0.065	0.377	1.196	1.131	MH-1217
1064	CBD	CBD	0.086	3,745	0.036	0.209	0.663	0.627	MH-1245
1065	MHR	MHR	0.085	3,716	0.035	0.188	0.599	0.564	MH-1171
1066	MR	MR	0.147	6,420	0.061	0.188	0.625	0.564	MH-1089
1067	Vacant	MR	0.161	7,000	0.067	0.310	0.997	0.930	MH-2298
1068	CBD	CBD	0.070	3,052	0.029	0.170	0.539	0.510	MH-1215
1069	CBD	CBD	0.512	22,303	0.213	1.244	3.945	3.732	MH-1245
1070	MHR	MHR	0.398	17,318	0.166	0.188	0.730	0.564	MH-1171
1071	HR	HR	0.206	8,981	0.086	0.391	1.259	1.173	MH-1149
1072	Vacant	MR	0.053	2,310	0.022	0.102	0.328	0.306	MH-2298
1073	HR	HR	0.341	14,871	0.142	0.646	2.080	1.938	MH-1097
1074	MHR	MHR	0.120	5,236	0.050	0.188	0.614	0.564	MH-1175
1075	Vacant	MR	0.139	6,059	0.058	0.268	0.862	0.804	MH-2298
1076	MHR	MHR	0.070	3,032	0.029	0.188	0.593	0.564	MH-1175
1077	CBD	CBD	0.226	9,838	0.094	0.549	1.741	1.647	MH-1217
1078	MR	MR	0.158	6,878	0.066	0.188	0.630	0.564	MH-1089
1079	Vacant	MR	0.155	6,735	0.065	0.298	0.959	0.894	MH-2298
1080	MR	MR	0.206	8,954	0.086	0.188	0.650	0.564	MH-1209
1081	MHR	MHR	0.217	9,442	0.090	0.188	0.654	0.564	MH-1171
1082	MHR	MHR	0.111	4,837	0.046	0.188	0.610	0.564	MH-1171
1083	Vacant	MR	0.139	6,036	0.058	0.268	0.862	0.804	MH-2298
1084	Vacant	MR	6.280	273,536	2.617	12.089	38.884	36.267	MH-2298
1085	CBD	CBD	0.134	5,834	0.056	0.326	1.034	0.978	MH-1215
1086	MR	MR	0.175	7,627	0.073	0.188	0.637	0.564	MH-1089
1087	MR	MR	0.258	11,244	0.108	0.188	0.672	0.564	MH-2064
1088	Vacant	MR	0.189	8,232	0.079	0.364	1.171	1.092	MH-2298
1089	MR	MR	0.219	9,545	0.091	0.188	0.655	0.564	MH-1089
1090	LR	LR	0.192	8,382	0.080	0.219	0.737	0.657	MH-1137
1091	MR	MR	0.350	15,265	0.146	0.188	0.710	0.564	MH-2016
1092	MR	MR	0.146	6,358	0.061	0.281	0.904	0.843	MH-2298
1093	MHR	MHR	0.110	4,787	0.046	0.188	0.610	0.564	MH-1181
1094	MR	MR	0.162	7,076	0.068	0.188	0.632	0.564	MH-1089
1095	CBD	CBD	0.860	37,445	0.358	2.090	6.628	6.270	MH-30114
1096	Vacant	MR	0.134	5,816	0.056	0.258	0.830	0.774	MH-2298
1097	MHR	MHR	0.057	2,500	0.024	0.188	0.588	0.564	MH-1175
1098	CBD	CBD	0.325	14,167	0.135	0.790	2.505	2.370	MH-1209
1099	MR	MR	0.154	6,727	0.064	0.296	0.952	0.888	MH-2298
1100	CBD	CBD	0.219	9,549	0.091	0.532	1.687	1.596	MH-1217
1101	Vacant	MR	0.138	6,000	0.058	0.266	0.856	0.798	MH-2298
1102	MR	MR	0.209	9,095	0.087	0.188	0.651	0.564	MH-2028
1103	LR	LR	0.447	19,456	0.186	0.219	0.843	0.657	MH-1215
1104	HR	HR	0.170	7,388	0.071	0.322	1.037	0.966	MH-1097
1105	MR	MR	0.258	11,255	0.108	0.188	0.672	0.564	MH-2028
1106	LR	LR	0.226	9,844	0.094	0.219	0.751	0.657	MH-1137
1107	Vacant	MR	0.156	6,815	0.065	0.300	0.965	0.900	MH-2298
1108	MHR	MHR	0.342	14,903	0.143	0.188	0.707	0.564	MH-1181
1109	MR	MR	0.175	7,604	0.073	0.188	0.637	0.564	MH-1081
1110	MR	MR	0.159	6,938	0.066	0.188	0.630	0.564	MH-1089
1111	Vacant	MR	0.157	6,817	0.065	0.302	0.971	0.906	MH-2298
1112	MR	MR	0.184	8,028	0.077	0.188	0.641	0.564	MH-2094
1113	MR	MR	0.163	7,102	0.068	0.188	0.632	0.564	MH-2094
1114	MR	MR	0.152	6,626	0.063	0.188	0.627	0.564	MH-2094
1115	MR	MR	0.144	6,267	0.060	0.188	0.624	0.564	MH-2094
1116	MR	MR	0.154	6,692	0.064	0.188	0.628	0.564	MH-2094
1117	MR	MR	0.157	6,832	0.065	0.188	0.629	0.564	MH-2094
1118	MR	MR	0.148	6,429	0.062	0.188	0.626	0.564	MH-2094
1119	HR	HR	0.171	7,469	0.071	0.324	1.043	0.972	MH-1097
1120	MR	MR	0.163	7,098	0.068	0.188	0.632	0.564	MH-2094
1121	MR	MR	0.147	6,386	0.061	0.188	0.625	0.564	MH-2094
1122	MR	MR	0.151	6,577	0.063	0.188	0.627	0.564	MH-2094
1123	MR	MR	0.157	6,833	0.065	0.188	0.629	0.564	MH-2094
1124	MR	MR	0.158	6,893	0.066	0.188	0.630	0.564	MH-2094
1125	Vacant	MR	0.147	6,382	0.061	0.283	0.910	0.849	MH-2298
1126	MR	MR	0.141	6,148	0.059	0.188	0.623	0.564	MH-2094
1127	MR	MR	0.158	6,897	0.066	0.188	0.630	0.564	MH-2094
1128	MR	MR	0.152	6,636	0.063	0.188	0.627	0.564	MH-2094
1129	CBD	CBD	0.331	14,409	0.138	0.805	2.553	2.415	MH-1217
1130	MR	MR	0.304	13,229	0.127	0.188	0.691	0.564	MH-1089
1131	MR	MR	0.155	6,751	0.065	0.188	0.629	0.564	MH-2094
1132	MR	MR	0.153	6,646	0.064	0.188	0.628	0.564	MH-2094
1133	MR	MR	0.166	7,216	0.069	0.188	0.633	0.564	MH-2094
1134	MR	MR	0.177	7,725	0.074	0.188	0.638	0.564	MH-2094
1135	MR	MR	0.217	9,437	0.090	0.188	0.654	0.564	MH-2094
1136	MR	MR	0.165	7,184	0.069	0.188	0.633	0.564	MH-2094
1137	MR	MR	0.278	12,115	0.116	0.188	0.680	0.564	MH-2028
1138	MR	MR	0.247	10,754	0.103	0.188	0.667	0.564	MH-2028
1139	MR	MR	0.252	10,996	0.105	0.188	0.669	0.564	MH-2028
1140	MR	MR	0.183	7,987	0.076	0.188	0.640	0.564	MH-2028
1141	MR	MR	0.320	13,944	0.133	0.188	0.697	0.564	MH-1163
1142	LR	LR	0.164	7,140	0.068	0.219	0.725	0.657	MH-1137
1143	MR	MR	0.151	6,569	0.063	0.291	0.936	0.873	MH-2298
1144	MR	MR	0.298	12,979	0.124	0.574	1.846	1.722	MH-2016
1145	Vacant	MR	0.145	6,307	0.060	0.279	0.897	0.837	MH-2298
1146	MR	MR	0.140	6,113	0.058	0.269	0.865	0.807	MH-2298
1147	MR	MR	0.139	6,038	0.058	0.188	0.622	0.564	MH-1081
1148	CBD	CBD	0.130	5,642	0.054	0.316	1.002	0.948	MH-1245
1149	MR	MR	0.193	8,389	0.080	0.372	1.196	1.116	MH-2298
1150	MR	MR	0.262	11,406	0.109	0.188	0.673	0.564	MH-2028
1151	LR	LR	0.166	7,228	0.069	0.219	0.726	0.657	MH-1137
1152	Vacant	MR	0.152	6,600	0.063	0.293	0.942	0.879	MH-2298
1153	CBD	CBD	0.196	8,524	0.082	0.476	1.510	1.428	MH-1245
1154	LR	LR	0.136	5,911	0.057	0.219	0.714	0.657	MH-1215
1155	MR	MR	0.140	6,102	0.058	0.188	0.622	0.564	MH-1081
1156	LR	LR	0.202	8,813	0.084	0.219	0.741	0.657	MH-1097
1157	CBD	CBD	0.309	13,447	0.129	0.751	2.382	2.253	MH-1201
1158	LR	LR	0.424	18,474	0.177	0.219	0.834	0.657	MH-1079
1159	Vacant	MR	0.140	6,089	0.058	0.269	0.865	0.807	MH-2298
1160	CBD	CBD	0.210	9,126	0.088	0.510	1.618	1.530	MH-1163
1161	Vacant	MR	0.152	6,600	0.063	0.293	0.942	0.879	MH-2298
1162	LR	LR	0.197	8,599	0.082	0.219	0.739	0.657	MH-1137
1163	MR	MR	0.215	9,354	0.090	0.414	1.332	1.242	MH-2298
1164	MR	MR	0.139	6,067	0.058	0.268	0.862	0.804	MH-2298
1165	MR	MR	0.142	6,177	0.059	0.188	0.623	0.564	MH-1081
1166	LR	LR	0.266	11,568	0.111	0.219	0.768	0.657	MH-1091
1167	CBD	CBD	0.176	7,688	0.073	0.428	1.357	1.284	MH-1245
1168	MR	MR	0.162	7,060	0.068	0.188	0.632	0.564	MH-2028
1169	LR	LR	0.264	11,484	0.110	0.219	0.767	0.657	MH-1217
1170	MR	MR	0.150	6,528	0.063	0.289	0.930	0.867	MH-2298
1171	CBD	CBD	0.239	10,416	0.100	0.581	1.843	1.743	MH-1163
1172	Vacant	MR	0.152	6,600	0.063	0.293	0.942	0.879	MH-2298
1173	MR	MR	0.149	6,497	0.062	0.188	0.626	0.564	MH-1081
1174	LR	LR	0.116	5,070	0.048	0.219	0.705	0.657	MH-1137
1175	CBD	CBD	0.116	5,040	0.048	0.282	0.894	0.846	MH-1217
1176	CBD	CBD	0.182	7,912	0.076	0.442	1.402	1.326	MH-1245
1177	LR	LR	0.201	8,750	0.084	0.219	0.741	0.657	MH-1091
1178	LR	LR	0.343	14,959	0.143	0.219	0.800	0.657	MH-1079
1179	MR	MR	0.178	7,750	0.074	0.188	0.638	0.564	MH-2092

Parcel ID	Existing Land Use	Buildout Land Use	Area (acres)	Area (ft^2)	I/I (gpm)	Buildout ADWF (gpm)	Buildout PWWF (gpm)	Buildout PDWF (gpm)	Manhole
1180	MR	MR	0.158	6,884	0.066	0.188	0.630	0.564	MH-2092
1181	MR	MR	0.145	6,333	0.060	0.188	0.624	0.564	MH-2092
1182	MR	MR	0.140	6,095	0.058	0.188	0.622	0.564	MH-2092
1183	MR	MR	0.147	6,409	0.061	0.188	0.625	0.564	MH-2092
1184	Vacant	MR	0.139	6,075	0.058	0.268	0.862	0.804	MH-2298
1185	MR	MR	0.152	6,605	0.063	0.188	0.627	0.564	MH-2092
1186	MR	MR	0.143	6,223	0.060	0.188	0.624	0.564	MH-2092
1187	Vacant	MR	0.152	6,600	0.063	0.293	0.942	0.879	MH-2298
1188	MR	MR	0.158	6,872	0.066	0.188	0.630	0.564	MH-2092
1189	MR	MR	0.142	6,195	0.059	0.188	0.623	0.564	MH-2090
1190	MR	MR	0.147	6,387	0.061	0.188	0.625	0.564	MH-2090
1191	MR	MR	0.154	6,695	0.064	0.188	0.628	0.564	MH-2090
1192	MR	MR	0.153	6,656	0.064	0.188	0.628	0.564	MH-2090
1193	MR	MR	0.139	6,044	0.058	0.188	0.622	0.564	MH-2090
1194	MR	MR	0.153	6,674	0.064	0.188	0.628	0.564	MH-2090
1195	MR	MR	0.145	6,307	0.060	0.188	0.624	0.564	MH-2090
1196	MR	MR	0.153	6,649	0.064	0.188	0.628	0.564	MH-2090
1197	MR	MR	0.134	5,822	0.056	0.188	0.620	0.564	MH-2088
1198	MR	MR	0.194	8,463	0.081	0.188	0.645	0.564	MH-2088
1199	MR	MR	0.184	8,001	0.077	0.188	0.641	0.564	MH-2088
1200	CBD	CBD	0.149	6,498	0.062	0.362	1.148	1.086	MH-1217
1201	LR	LR	0.137	5,979	0.057	0.219	0.714	0.657	MH-1145
1202	MR	MR	0.134	5,822	0.056	0.188	0.620	0.564	MH-1081
1203	MR	MR	0.144	6,274	0.060	0.277	0.891	0.831	MH-2298
1204	MR	MR	0.180	7,835	0.075	0.188	0.639	0.564	MH-2028
1205	MR	MR	0.245	10,676	0.102	0.472	1.518	1.416	MH-2298
1206	CBD	CBD	0.246	10,736	0.103	0.598	1.897	1.794	MH-1163
1207	MR	MR	0.298	12,973	0.124	0.188	0.688	0.564	MH-2016
1208	LR	LR	0.326	14,179	0.136	0.219	0.793	0.657	MH-1093
1209	Vacant	MR	0.150	6,543	0.063	0.289	0.930	0.867	MH-2298
1210	CBD	CBD	0.116	5,055	0.048	0.282	0.894	0.846	MH-1245
1211	LR	LR	0.248	10,788	0.103	0.219	0.760	0.657	MH-1145
1212	LR	LR	0.227	9,878	0.095	0.219	0.752	0.657	MH-1137
1213	MR	MR	0.155	6,747	0.065	0.188	0.629	0.564	MH-1081
1214	MR	MR	0.159	6,941	0.066	0.306	0.984	0.918	MH-2298
1215	CBD	CBD	0.125	5,466	0.052	0.304	0.964	0.912	MH-1217
1216	Vacant	MR	0.239	10,403	0.100	0.460	1.480	1.380	MH-2298
1217	MR	MR	0.166	7,225	0.069	0.188	0.633	0.564	MH-2088
1218	MR	MR	0.174	7,589	0.073	0.188	0.637	0.564	MH-2028
1219	MR	MR	0.204	8,867	0.085	0.188	0.649	0.564	MH-2088
1220	CBD	CBD	0.162	7,053	0.068	0.394	1.250	1.182	MH-1163
1221	CBD	CBD	0.244	10,641	0.102	0.593	1.881	1.779	MH-1203
1222	CBD	CBD	0.188	8,188	0.078	0.457	1.449	1.371	MH-1217
1223	PQP	PQP	2.189	95,342	0.912	17.361	52.995	52.083	MH-1145
1224	Vacant	MR	0.203	8,830	0.085	0.391	1.258	1.173	MH-2298
1225	MR	MR	0.213	9,292	0.089	0.188	0.653	0.564	MH-2028
1226	MR	MR	0.196	8,539	0.082	0.188	0.646	0.564	MH-2028
1227	LR	LR	0.185	8,055	0.077	0.219	0.734	0.657	MH-1079
1228	LR	LR	0.148	6,442	0.062	0.219	0.719	0.657	MH-1075
1229	MR	MR	0.144	6,259	0.060	0.277	0.891	0.831	MH-2298
1230	LR	LR	0.174	7,566	0.073	0.219	0.730	0.657	MH-1145
1231	CBD	CBD	0.594	25,880	0.248	1.444	4.580	4.332	MH-1245
1232	Vacant	MHR	0.489	21,293	0.204	0.917	2.955	2.751	MH-2094
1233	LR	LR	0.319	13,903	0.133	0.219	0.790	0.657	MH-1165
1234	CBD	CBD	0.278	12,121	0.116	0.676	2.144	2.028	MH-1163
1235	CBD	CBD	0.304	13,259	0.127	0.739	2.344	2.217	MH-1219
1236	MR	MR	0.155	6,738	0.065	0.298	0.959	0.894	MH-2298
1237	MR	MR	0.326	14,190	0.136	0.188	0.700	0.564	MH-2016
1238	LR	LR	0.177	7,694	0.074	0.219	0.731	0.657	MH-1075
1239	LR	LR	0.154	6,698	0.064	0.219	0.721	0.657	MH-1079
1240	MR	MR	0.153	6,646	0.064	0.188	0.628	0.564	MH-2028
1241	MR	MR	0.159	6,920	0.066	0.306	0.984	0.918	MH-2298
1242	LR	LR	0.239	10,415	0.100	0.219	0.757	0.657	MH-1243
1243	MR	MR	0.128	5,557	0.053	0.246	0.791	0.738	MH-2298
1244	CBD	CBD	0.169	7,378	0.070	0.411	1.303	1.233	MH-1217
1245	MR	MR	0.174	7,583	0.073	0.188	0.637	0.564	MH-2088
1246	LR	LR	0.158	6,868	0.066	0.219	0.723	0.657	MH-1079
1247	MR	MR	0.141	6,163	0.059	0.188	0.623	0.564	MH-2028
1248	CBD	CBD	0.274	11,921	0.114	0.666	2.112	1.998	MH-1163
1249	LR	LR	0.229	9,974	0.095	0.219	0.752	0.657	MH-1145
1250	CBD	CBD	0.273	11,887	0.114	0.664	2.106	1.992	MH-1219
1251	MR	MR	0.132	5,743	0.055	0.254	0.817	0.762	MH-2298
1252	MR	MR	0.161	7,030	0.067	0.310	0.997	0.930	MH-2298
1253	LR	LR	0.187	8,130	0.078	0.219	0.735	0.657	MH-1079
1254	LR	LR	0.143	6,226	0.060	0.219	0.717	0.657	MH-1075
1255	LR	LR	0.160	6,964	0.067	0.219	0.724	0.657	MH-1163
1256	MR	MR	0.130	5,653	0.054	0.188	0.618	0.564	MH-2028
1257	LR	LR	0.111	4,829	0.046	0.219	0.703	0.657	MH-1217
1258	MR	MR	0.236	10,283	0.098	0.188	0.662	0.564	MH-2016
1259	Vacant	MR	0.151	6,582	0.063	0.291	0.936	0.873	MH-2298
1260	MR	MR	0.154	6,719	0.064	0.296	0.952	0.888	MH-2298
1261	LR	LR	0.170	7,416	0.071	0.219	0.728	0.657	MH-1079
1262	MR	MR	0.142	6,170	0.059	0.188	0.623	0.564	MH-2028
1263	LR	LR	0.162	7,039	0.068	0.219	0.725	0.657	MH-1163
1264	CBD	CBD	0.231	10,073	0.096	0.561	1.779	1.683	MH-1219
1265	MR	MR	0.181	7,902	0.075	0.188	0.639	0.564	MH-2092
1266	MR	MR	0.149	6,484	0.062	0.188	0.626	0.564	MH-2092
1267	MR	MR	0.155	6,767	0.065	0.188	0.629	0.564	MH-2092
1268	MR	MR	0.147	6,406	0.061	0.188	0.625	0.564	MH-2092
1269	MR	MR	0.146	6,348	0.061	0.188	0.625	0.564	MH-2092
1270	MR	MR	0.144	6,260	0.060	0.188	0.624	0.564	MH-2092
1271	MR	MR	0.153	6,685	0.064	0.188	0.628	0.564	MH-2092
1272	MR	MR	0.144	6,285	0.060	0.188	0.624	0.564	MH-2090
1273	MR	MR	0.146	6,348	0.061	0.188	0.625	0.564	MH-2090
1274	MR	MR	0.138	6,016	0.058	0.188	0.622	0.564	MH-2090
1275	MR	MR	0.151	6,597	0.063	0.188	0.627	0.564	MH-2090
1276	MR	MR	0.159	6,921	0.066	0.188	0.630	0.564	MH-2090
1277	MR	MR	0.149	6,492	0.062	0.188	0.626	0.564	MH-2090
1278	MR	MR	0.143	6,218	0.060	0.188	0.624	0.564	MH-2090
1279	MR	MR	0.142	6,201	0.059	0.188	0.623	0.564	MH-2090
1280	CBD	CBD	0.407	17,711	0.170	0.989	3.137	2.967	MH-30114
1281	MR	MR	0.151	6,560	0.063	0.188	0.627	0.564	MH-2090
1282	MR	MR	0.138	5,997	0.058	0.188	0.622	0.564	MH-2088
1283	MR	MR	0.155	6,769	0.065	0.188	0.629	0.564	MH-2088
1284	CBD	CBD	0.300	13,060	0.125	0.729	2.312	2.187	MH-1163
1285	LR	LR	0.172	7,491	0.072	0.219	0.729	0.657	MH-1079
1286	MR	MR	0.141	6,123	0.059	0.271	0.872	0.813	MH-2298
1287	PQP	PQP	0.150	6,516	0.063	0.000	0.063	0.000	MH-1243
1288	MR	MR	0.181	7,902	0.075	0.188	0.639	0.564	MH-2016
1289	LR	LR	0.170	7,408	0.071	0.219	0.728	0.657	MH-1351
1290	LR	LR	0.131	5,710	0.055	0.219	0.712	0.657	MH-1145
1291	LR	LR	0.212	9,223	0.088	0.219	0.745	0.657	MH-1163
1292	MR	MR	0.176	7,672	0.073	0.188	0.637	0.564	MH-2016
1293	MR	MR	0.209	9,100	0.087	0.188	0.651	0.564	MH-2028
1294	CBD	CBD	0.133	5,775	0.055	0.323	1.024	0.969	MH-1217
1295	MR	MR	0.147	6,418	0.061	0.188	0.625	0.564	MH-2088
1296	CBD	CBD	0.186	8,083	0.078	0.452	1.434	1.356	MH-1219
1297	LR	LR	0.148	6,453	0.062	0.219	0.719	0.657	MH-1075

Attributes of parcel_loading_to_manhole.shp

Parcel ID	Existing Land Use	Buildout Land Use	Area (acres)	Area (ft^2)	I/I (gpm)	Buildout ADWF (gpm)	Buildout PWWF (gpm)	Buildout PDWF (gpm)	Manhole
1298	LR	LR	0.166	7,231	0.069	0.219	0.726	0.657	MH-1075
1299	LR	LR	0.130	5,684	0.054	0.219	0.711	0.657	MH-1145
1300	MR	MR	0.153	6,673	0.064	0.188	0.628	0.564	MH-2016
1301	LR	LR	0.170	7,407	0.071	0.219	0.728	0.657	MH-1351
1302	MR	MR	0.232	10,112	0.097	0.188	0.661	0.564	MH-2016
1303	LR	LR	0.447	19,488	0.186	0.219	0.843	0.657	MH-1163
1304	CBD	CBD	0.426	18,541	0.178	1.035	3.283	3.105	MH-1163
1305	MR	MR	0.178	7,733	0.074	0.188	0.638	0.564	MH-2088
1306	MR	MR	0.151	6,592	0.063	0.188	0.627	0.564	MH-2016
1307	LR	LR	0.178	7,764	0.074	0.219	0.731	0.657	MH-1145
1308	CBD	CBD	0.059	2,569	0.025	0.143	0.454	0.429	MH-1203
1309	MR	MR	0.189	8,214	0.079	0.364	1.171	1.092	MH-2298
1310	LR	LR	0.170	7,407	0.071	0.219	0.728	0.657	MH-1351
1311	MR	MR	0.133	5,774	0.055	0.256	0.823	0.768	MH-2298
1312	MR	MR	0.129	5,624	0.054	0.188	0.618	0.564	MH-2016
1313	CBD	CBD	0.102	4,432	0.043	0.248	0.787	0.744	MH-1219
1314	CBD	CBD	0.095	4,136	0.040	0.231	0.733	0.693	MH-1203
1315	MR	MR	0.141	6,141	0.059	0.271	0.872	0.813	MH-2298
1316	MR	MR	0.177	7,716	0.074	0.188	0.638	0.564	MH-2016
1317	LR	LR	0.134	5,830	0.056	0.219	0.713	0.657	MH-1145
1318	LR	LR	0.170	7,384	0.071	0.219	0.728	0.657	MH-1351
1319	MR	MR	0.165	7,183	0.069	0.188	0.633	0.564	MH-2016
1320	LR	LR	0.132	5,763	0.055	0.219	0.712	0.657	MH-1079
1321	LR	LR	0.204	8,894	0.085	0.219	0.742	0.657	MH-1075
1322	MR	MR	0.228	9,949	0.095	0.188	0.659	0.564	MH-2016
1323	LR	LR	0.178	7,740	0.074	0.219	0.731	0.657	MH-1075
1324	LR	LR	0.403	17,533	0.168	0.219	0.825	0.657	MH-1163
1325	PQP	PQP	0.334	14,566	0.139	0.812	2.575	2.436	MH-1221
1326	LR	LR	0.227	9,878	0.095	0.219	0.752	0.657	MH-1141
1327	LR	LR	0.121	5,290	0.050	0.219	0.707	0.657	MH-1145
1328	MR	MR	0.219	9,521	0.091	0.188	0.655	0.564	MH-2082
1329	MHR	MHR	0.149	6,473	0.062	0.188	0.626	0.564	MH-2084
1330	MR	MR	0.150	6,513	0.063	0.188	0.627	0.564	MH-2082
1331	MR	MR	0.148	6,451	0.062	0.188	0.626	0.564	MH-2082
1332	MR	MR	0.151	6,568	0.063	0.188	0.627	0.564	MH-2082
1333	MR	MR	0.155	6,767	0.065	0.188	0.629	0.564	MH-2082
1334	MR	MR	0.153	6,643	0.064	0.188	0.628	0.564	MH-2082
1335	MR	MR	0.151	6,588	0.063	0.188	0.627	0.564	MH-2082
1336	MR	MR	0.143	6,223	0.060	0.188	0.624	0.564	MH-2082
1337	LR	LR	0.248	10,818	0.103	0.219	0.760	0.657	MH-1351
1338	MR	MR	0.125	5,465	0.052	0.241	0.775	0.723	MH-2298
1339	MR	MR	0.152	6,617	0.063	0.188	0.627	0.564	MH-2082
1340	MR	MR	0.150	6,515	0.063	0.188	0.627	0.564	MH-2082
1341	MR	MR	0.151	6,576	0.063	0.188	0.627	0.564	MH-2082
1342	MR	MR	0.161	7,032	0.067	0.188	0.631	0.564	MH-2090
1343	MR	MR	0.158	6,896	0.066	0.188	0.630	0.564	MH-2090
1344	LR	LR	0.142	6,178	0.059	0.219	0.716	0.657	MH-1079
1345	MR	MR	0.202	8,787	0.084	0.188	0.648	0.564	MH-2090
1346	MR	MR	0.156	6,791	0.065	0.188	0.629	0.564	MH-2054
1347	CBD	CBD	0.118	5,142	0.049	0.287	0.910	0.861	MH-1203
1348	MR	MR	0.139	6,050	0.058	0.188	0.622	0.564	MH-2054
1349	MR	MR	0.173	7,533	0.072	0.188	0.636	0.564	MH-2054
1350	MR	MR	0.133	5,797	0.055	0.188	0.619	0.564	MH-2088
1351	LR	LR	0.175	7,616	0.073	0.219	0.730	0.657	MH-1079
1352	MR	MR	0.141	6,148	0.059	0.271	0.872	0.813	MH-2298
1353	LR	LR	0.410	17,853	0.171	0.219	0.828	0.657	MH-1163
1354	LR	LR	0.140	6,100	0.058	0.219	0.715	0.657	MH-1079
1355	MR	MR	0.152	6,628	0.063	0.293	0.942	0.879	MH-2298
1356	LR	LR	0.176	7,674	0.073	0.219	0.730	0.657	MH-1079
1357	CBD	CBD	0.101	4,381	0.042	0.245	0.777	0.735	MH-1219
1358	LR	LR	0.156	6,800	0.065	0.219	0.722	0.657	MH-1141
1359	PQP	PQP	9.193	400,439	3.831	24.306	76.749	72.918	MH-1119
1360	MR	MR	0.165	7,192	0.069	0.318	1.023	0.954	MH-2298
1361	MR	MR	0.166	7,237	0.069	0.320	1.029	0.960	MH-2298
1362	MR	MR	0.153	6,682	0.064	0.188	0.628	0.564	MH-2016
1363	MR	MR	0.225	9,785	0.094	0.188	0.658	0.564	MH-2016
1364	MR	MR	0.164	7,148	0.068	0.188	0.632	0.564	MH-2016
1365	MR	MR	0.177	7,728	0.074	0.341	1.097	1.023	MH-2298
1366	LR	LR	0.154	6,725	0.064	0.219	0.721	0.657	MH-1079
1367	LR	LR	0.185	8,072	0.077	0.219	0.734	0.657	MH-1079
1368	LR	LR	0.165	7,184	0.069	0.219	0.726	0.657	MH-1141
1369	CBD	CBD	0.077	3,365	0.032	0.187	0.593	0.561	MH-1221
1370	LR	LR	0.120	5,214	0.050	0.219	0.707	0.657	MH-1163
1371	LR	LR	0.093	4,059	0.039	0.219	0.696	0.657	MH-1145
1372	MR	MR	0.151	6,564	0.063	0.188	0.627	0.564	MH-2054
1373	LR	LR	0.115	5,012	0.048	0.219	0.705	0.657	MH-1145
1374	CBD	CBD	0.169	7,364	0.070	0.411	1.303	1.233	MH-1221
1375	MR	MR	0.135	5,897	0.056	0.188	0.620	0.564	MH-2016
1376	CBD	CBD	0.203	8,835	0.085	0.493	1.564	1.479	MH-1221
1377	LR	LR	0.183	7,955	0.076	0.219	0.733	0.657	MH-1079
1378	MHR	MHR	0.131	5,724	0.055	0.188	0.619	0.564	MH-2084
1379	LR	LR	0.215	9,350	0.090	0.219	0.747	0.657	MH-1079
1380	LR	LR	0.123	5,355	0.051	0.219	0.708	0.657	MH-1141
1381	CBD	CBD	0.113	4,911	0.047	0.275	0.872	0.825	MH-1219
1382	MR	MR	0.151	6,559	0.063	0.291	0.936	0.873	MH-2298
1383	MR	MR	0.148	6,455	0.062	0.188	0.626	0.564	MH-2016
1384	LR	LR	0.127	5,537	0.053	0.219	0.710	0.657	MH-1055
1385	CBD	CBD	0.148	6,437	0.062	0.360	1.142	1.080	MH-1221
1386	LR	LR	0.184	8,009	0.077	0.219	0.734	0.657	MH-1079
1387	MR	MR	0.148	6,444	0.062	0.188	0.626	0.564	MH-2016
1388	MR	MR	0.158	6,878	0.066	0.188	0.630	0.564	MH-2016
1389	MR	MR	0.226	9,848	0.094	0.188	0.658	0.564	MH-2016
1390	LR	LR	0.156	6,804	0.065	0.219	0.722	0.657	MH-1141
1391	LR	LR	0.126	5,468	0.053	0.219	0.710	0.657	MH-1073
1392	PQP	PQP	2.622	114,220	1.093	6.373	20.212	19.119	MH-1163
1393	LR	LR	0.144	6,289	0.060	0.219	0.717	0.657	MH-1055
1394	LR	LR	0.346	15,088	0.144	0.219	0.801	0.657	MH-1079
1395	MR	MR	0.133	5,774	0.055	0.256	0.823	0.768	MH-2298
1396	CBD	CBD	0.076	3,309	0.032	0.185	0.587	0.555	MH-1221
1397	LR	LR	0.165	7,183	0.069	0.219	0.726	0.657	MH-1079
1398	LR	LR	0.135	5,894	0.056	0.219	0.713	0.657	MH-1073
1399	LR	LR	0.158	6,896	0.066	0.219	0.723	0.657	MH-1141
1400	CBD	CBD	0.176	7,648	0.073	0.428	1.357	1.284	MH-1221
1401	MR	MR	0.165	7,190	0.069	0.188	0.633	0.564	MH-2016
1402	MR	MR	0.187	8,146	0.078	0.188	0.642	0.564	MH-2016
1403	Vacant	MHR	0.608	26,487	0.253	1.140	3.673	3.420	MH-2340
1404	MR	MR	0.166	7,229	0.069	0.320	1.029	0.960	MH-2298
1405	LR	LR	0.129	5,627	0.054	0.219	0.711	0.657	MH-1055
1406	MR	MR	0.161	7,010	0.067	0.310	0.997	0.930	MH-2298
1407	MHR	MHR	0.136	5,943	0.057	0.188	0.621	0.564	MH-2084
1408	MR	MR	0.149	6,477	0.062	0.287	0.923	0.861	MH-2298
1409	LR	LR	0.133	5,802	0.055	0.219	0.712	0.657	MH-1073
1410	MR	MR	0.175	7,633	0.073	0.188	0.637	0.564	MH-2016
1411	CBD	CBD	0.114	4,975	0.048	0.277	0.879	0.831	MH-1221
1412	LR	LR	0.170	7,398	0.071	0.219	0.728	0.657	MH-1079
1413	PQP	PQP	0.101	4,390	0.042	0.245	0.777	0.735	MH-1219
1414	MR	MR	0.236	10,262	0.098	0.188	0.662	0.564	MH-2016
1415	MR	MR	0.146	6,348	0.061	0.188	0.625	0.564	MH-2016

Attributes of parcel_loading_to_manhole.shp

Parcel ID	Existing Land Use	Buildout Land Use	Area (acres)	Area (ft^2)	I/I (gpm)	Buildout ADWF (gpm)	Buildout PWWF (gpm)	Buildout PDWF (gpm)	Manhole
1416	LR	LR	0.109	4,742	0.045	0.219	0.702	0.657	MH-1055
1417	MR	MR	0.193	8,387	0.080	0.372	1.196	1.116	MH-2298
1418	MR	MR	0.126	5,500	0.053	0.243	0.782	0.729	MH-2298
1419	LR	LR	0.145	6,327	0.060	0.219	0.717	0.657	MH-1073
1420	CBD	CBD	0.049	2,150	0.020	0.119	0.377	0.357	MH-1221
1421	LR	LR	0.133	5,796	0.055	0.219	0.712	0.657	MH-1141
1422	MR	MR	0.215	9,365	0.090	0.188	0.654	0.564	MH-2054
1423	MR	MR	0.219	9,524	0.091	0.188	0.655	0.564	MH-2054
1424	MR	MR	0.222	9,676	0.093	0.188	0.657	0.564	MH-2054
1425	MR	MR	0.198	8,605	0.083	0.188	0.647	0.564	MH-2054
1426	MR	MR	0.204	8,891	0.085	0.188	0.649	0.564	MH-2054
1427	LR	LR	0.113	4,912	0.047	0.219	0.704	0.657	MH-1055
1428	MR	MR	0.230	10,038	0.096	0.188	0.660	0.564	MH-2054
1429	CBD	CBD	0.068	2,974	0.028	0.165	0.523	0.495	MH-1221
1430	MR	MR	0.205	8,913	0.085	0.188	0.649	0.564	MH-2054
1431	MR	MR	0.219	9,558	0.091	0.188	0.655	0.564	MH-2054
1432	MR	MR	0.177	7,697	0.074	0.188	0.638	0.564	MH-2054
1433	MR	MR	0.173	7,542	0.072	0.188	0.636	0.564	MH-2016
1434	MR	MR	0.148	6,442	0.062	0.188	0.626	0.564	MH-2016
1435	MR	MR	0.144	6,277	0.060	0.277	0.891	0.831	MH-2298
1436	CBD	CBD	0.110	4,776	0.046	0.267	0.847	0.801	MH-1221
1437	MR	MR	0.177	7,710	0.074	0.188	0.638	0.564	MH-2054
1438	LR	LR	0.171	7,451	0.071	0.219	0.728	0.657	MH-1049
1439	LR	LR	0.130	5,653	0.054	0.219	0.711	0.657	MH-1073
1440	LR	LR	0.324	14,134	0.135	0.219	0.792	0.657	MH-1073
1441	LR	LR	0.097	4,231	0.040	0.219	0.697	0.657	MH-1163
1442	LR	LR	0.133	5,793	0.055	0.219	0.712	0.657	MH-1055
1443	CBD	CBD	0.245	10,668	0.102	0.595	1.887	1.785	MH-1141
1444	PQP	PQP	0.132	5,768	0.055	0.321	1.018	0.963	MH-1221
1445	MR	MR	0.152	6,625	0.063	0.188	0.627	0.564	MH-2016
1446	CBD	CBD	0.073	3,190	0.030	0.177	0.561	0.531	MH-1221
1447	MHR	MHR	0.135	5,868	0.056	0.188	0.620	0.564	MH-2084
1448	MR	MR	0.130	5,660	0.054	0.250	0.804	0.750	MH-2298
1449	CBD	CBD	0.227	9,875	0.095	0.552	1.751	1.656	MH-1221
1450	LR	LR	0.139	6,040	0.058	0.219	0.715	0.657	MH-1073
1451	MR	MR	0.256	11,172	0.107	0.188	0.671	0.564	MH-2016
1452	MR	MR	0.149	6,469	0.062	0.188	0.626	0.564	MH-2016
1453	LR	LR	0.143	6,231	0.060	0.219	0.717	0.657	MH-1055
1454	MR	MR	0.160	6,986	0.067	0.188	0.631	0.564	MH-2016
1455	PQP	PQP	0.518	22,543	0.216	0.000	0.216	0.000	MH-1163
1456	LR	LR	0.150	6,544	0.063	0.219	0.720	0.657	MH-1049
1457	MR	MR	0.136	5,926	0.057	0.262	0.843	0.786	MH-2298
1458	LR	LR	0.266	11,567	0.111	0.219	0.768	0.657	MH-1073
1459	LR	LR	0.155	6,748	0.065	0.219	0.722	0.657	MH-1049
1460	CBD	CBD	0.184	8,029	0.077	0.447	1.418	1.341	MH-1129
1461	LR	LR	0.189	8,233	0.079	0.219	0.736	0.657	MH-1079
1462	MR	MR	0.156	6,779	0.065	0.188	0.629	0.564	MH-2054
1463	MR	MR	0.211	9,200	0.088	0.188	0.652	0.564	MH-2016
1464	MR	MR	0.144	6,280	0.060	0.188	0.624	0.564	MH-2054
1465	MR	MR	0.144	6,264	0.060	0.188	0.624	0.564	MH-2054
1466	MR	MR	0.149	6,475	0.062	0.188	0.626	0.564	MH-2054
1467	MR	MR	0.140	6,087	0.058	0.269	0.865	0.807	MH-2298
1468	LR	LR	0.131	5,690	0.055	0.219	0.712	0.657	MH-1049
1469	MR	MR	1.858	80,927	0.774	0.188	1.338	0.564	MH-2016
1470	MR	MR	0.150	6,517	0.063	0.188	0.627	0.564	MH-2054
1471	CBD	CBD	0.214	9,307	0.089	0.520	1.649	1.560	MH-1223
1472	MR	MR	0.159	6,927	0.066	0.188	0.630	0.564	MH-2054
1473	MR	MR	0.151	6,559	0.063	0.188	0.627	0.564	MH-2054
1474	LR	LR	0.123	5,340	0.051	0.219	0.708	0.657	MH-1055
1475	MHR	MHR	0.136	5,922	0.057	0.188	0.621	0.564	MH-2084
1476	CBD	CBD	0.142	6,172	0.059	0.345	1.094	1.035	MH-1141
1477	CBD	CBD	0.285	12,433	0.119	0.693	2.198	2.079	MH-1221
1478	MR	MR	0.184	8,016	0.077	0.188	0.641	0.564	MH-2054
1479	LR	LR	0.152	6,613	0.063	0.219	0.720	0.657	MH-1049
1480	LR	LR	0.126	5,500	0.053	0.219	0.710	0.657	MH-1079
1481	MR	MR	0.142	6,199	0.059	0.273	0.878	0.819	MH-2298
1482	MR	MR	0.179	7,793	0.075	0.188	0.639	0.564	MH-2054
1483	MR	MR	0.355	15,448	0.148	0.188	0.712	0.564	MH-2016
1484	LR	LR	0.099	4,317	0.041	0.219	0.698	0.657	MH-1073
1485	CBD	CBD	0.126	5,473	0.053	0.306	0.971	0.918	MH-1223
1486	LR	LR	0.301	13,094	0.125	0.219	0.782	0.657	MH-1049
1487	LR	LR	0.123	5,348	0.051	0.219	0.708	0.657	MH-1079
1488	LR	LR	0.127	5,530	0.053	0.219	0.710	0.657	MH-1073
1489	CBD	CBD	0.151	6,585	0.063	0.367	1.164	1.101	MH-1221
1490	MR	MR	0.148	6,432	0.062	0.188	0.626	0.564	MH-2054
1491	MR	MR	0.156	6,780	0.065	0.188	0.629	0.564	MH-2054
1492	MR	MR	0.111	4,832	0.046	0.214	0.688	0.642	MH-2298
1493	CBD	CBD	0.180	7,833	0.075	0.438	1.389	1.314	MH-1129
1494	MR	MR	0.210	9,151	0.088	0.188	0.652	0.564	MH-2016
1495	MR	MR	0.219	9,552	0.091	0.188	0.655	0.564	MH-2054
1496	MR	MR	0.185	8,053	0.077	0.356	1.145	1.068	MH-2298
1497	MR	MR	0.134	5,841	0.056	0.188	0.620	0.564	MH-2054
1498	PQP	PQP	0.505	21,976	0.210	1.227	3.891	3.681	MH-1163
1499	LR	LR	0.126	5,497	0.053	0.219	0.710	0.657	MH-1055
1500	CBD	CBD	0.062	2,691	0.026	0.151	0.479	0.453	MH-1223
1501	MR	MR	0.145	6,329	0.060	0.188	0.624	0.564	MH-2054
1502	MR	MR	0.124	5,402	0.052	0.188	0.616	0.564	MH-2054
1503	LR	LR	0.128	5,597	0.053	0.219	0.710	0.657	MH-1079
1504	MR	MR	0.301	13,132	0.125	0.188	0.689	0.564	MH-2016
1505	MR	MR	0.123	5,357	0.051	0.188	0.615	0.564	MH-2054
1506	MR	MR	0.148	6,447	0.062	0.188	0.626	0.564	MH-2054
1507	LR	LR	0.142	6,204	0.059	0.219	0.716	0.657	MH-1073
1508	CBD	CBD	0.064	2,777	0.027	0.156	0.495	0.468	MH-1223
1509	MHR	MHR	0.134	5,855	0.056	0.188	0.620	0.564	MH-2106
1510	LR	LR	0.164	7,135	0.068	0.219	0.725	0.657	MH-1073
1511	CBD	CBD	0.568	24,755	0.237	1.381	4.380	4.143	MH-1129
1512	LR	LR	0.249	10,850	0.104	0.219	0.761	0.657	MH-1119
1513	CBD	CBD	0.065	2,844	0.027	0.158	0.501	0.474	MH-1223
1514	MR	MR	0.135	5,882	0.056	0.188	0.620	0.564	MH-2054
1515	LR	LR	0.126	5,486	0.053	0.219	0.710	0.657	MH-1079
1516	LR	LR	0.187	8,127	0.078	0.219	0.735	0.657	MH-1141
1517	Vacant	MR	5.240	228,239	2.184	10.087	32.445	30.261	MH-1359
1518	PQP	PQP	0.110	4,801	0.046	0.267	0.847	0.801	MH-1163
1519	CBD	CBD	0.061	2,667	0.025	0.148	0.469	0.444	MH-1223
1520	LR	LR	0.124	5,415	0.052	0.219	0.709	0.657	MH-1073
1521	MR	MR	0.248	10,801	0.103	0.188	0.667	0.564	MH-2016
1522	CBD	CBD	0.063	2,747	0.026	0.153	0.485	0.459	MH-1223
1523	MR	MR	0.157	6,832	0.065	0.188	0.629	0.564	MH-2054
1524	MR	MR	0.138	6,003	0.058	0.188	0.622	0.564	MH-2054
1525	CBD	CBD	0.063	2,758	0.026	0.153	0.485	0.459	MH-1223
1526	MR	MR	0.205	8,933	0.085	0.188	0.649	0.564	MH-2054
1527	LR	LR	0.130	5,666	0.054	0.219	0.711	0.657	MH-1073
1528	MR	MR	0.135	5,893	0.056	0.188	0.620	0.564	MH-2054
1529	MR	MR	0.139	6,043	0.058	0.188	0.622	0.564	MH-2054
1530	CBD	CBD	0.354	15,428	0.148	0.860	2.728	2.580	MH-1223
1531	LR	LR	0.124	5,395	0.052	0.219	0.709	0.657	MH-1119
1532	MR	MR	0.134	5,831	0.056	0.188	0.620	0.564	MH-2054
1533	MR	MR	0.143	6,214	0.060	0.188	0.624	0.564	MH-2054

Attributes of parcel_loading_to_manhole.shp

Parcel ID	Existing Land Use	Buildout Land Use	Area (acres)	Area (ft^2)	I/I (gpm)	Buildout ADWF (gpm)	Buildout PWWF (gpm)	Buildout PDWF (gpm)	Manhole
1534	LR	LR	0.127	5,517	0.053	0.219	0.710	0.657	MH-1049
1535	CBD	CBD	0.126	5,493	0.053	0.306	0.971	0.918	MH-1223
1536	MR	MR	0.155	6,763	0.065	0.188	0.629	0.564	MH-2016
1537	MR	MR	0.169	7,371	0.070	0.188	0.634	0.564	MH-2054
1538	MHR	MHR	0.124	5,403	0.052	0.188	0.616	0.564	MH-2106
1539	MR	MR	0.211	9,175	0.088	0.188	0.652	0.564	MH-2016
1540	MR	MR	0.143	6,250	0.060	0.188	0.624	0.564	MH-2054
1541	MR	MR	0.207	9,028	0.086	0.188	0.650	0.564	MH-2016
1542	LR	LR	0.251	10,953	0.105	0.219	0.762	0.657	MH-1073
1543	LR	LR	0.248	10,821	0.103	0.219	0.760	0.657	MH-1051
1544	LR	LR	0.122	5,329	0.051	0.219	0.708	0.657	MH-1119
1545	CBD	CBD	0.050	2,175	0.021	0.122	0.387	0.366	MH-1223
1546	CBD	CBD	0.192	8,378	0.080	0.467	1.481	1.401	MH-1129
1547	LR	LR	0.139	6,067	0.058	0.219	0.715	0.657	MH-1051
1548	CBD	CBD	0.050	2,170	0.021	0.122	0.387	0.366	MH-1223
1549	MR	MR	0.220	9,591	0.092	0.188	0.656	0.564	MH-2016
1550	LR	LR	0.130	5,680	0.054	0.219	0.711	0.657	MH-1119
1551	LR	LR	0.137	5,986	0.057	0.219	0.714	0.657	MH-1049
1552	CBD	CBD	0.239	10,401	0.100	0.581	1.843	1.743	MH-1223
1553	MR	MR	0.154	6,714	0.064	0.188	0.628	0.564	MH-2054
1554	MR	MR	0.140	6,080	0.058	0.188	0.622	0.564	MH-2054
1555	LR	LR	0.148	6,443	0.062	0.219	0.719	0.657	MH-1051
1556	LR	LR	0.129	5,613	0.054	0.219	0.711	0.657	MH-1049
1557	MR	MR	0.144	6,259	0.060	0.188	0.624	0.564	MH-2054
1558	MR	MR	0.144	6,276	0.060	0.188	0.624	0.564	MH-2054
1559	MR	MR	0.180	7,845	0.075	0.188	0.639	0.564	MH-2054
1560	MR	MR	0.259	11,277	0.108	0.188	0.672	0.564	MH-2016
1561	MR	MR	0.220	9,562	0.092	0.188	0.656	0.564	MH-2054
1562	MR	MR	0.133	5,813	0.055	0.188	0.619	0.564	MH-2054
1563	LR	LR	0.124	5,393	0.052	0.219	0.709	0.657	MH-1119
1564	MR	MR	0.164	7,161	0.068	0.188	0.632	0.564	MH-2016
1565	LR	LR	0.135	5,890	0.056	0.219	0.713	0.657	MH-1049
1566	LR	LR	0.295	12,836	0.123	0.219	0.780	0.657	MH-1073
1567	MR	MR	0.136	5,925	0.057	0.188	0.621	0.564	MH-2054
1568	MHR	MHR	0.141	6,121	0.059	0.188	0.623	0.564	MH-2106
1569	LR	LR	0.135	5,886	0.056	0.219	0.713	0.657	MH-1051
1570	CBD	CBD	0.157	6,850	0.065	0.382	1.211	1.146	MH-1225
1571	CBD	CBD	0.086	3,760	0.036	0.209	0.663	0.627	MH-1223
1572	MR	MR	0.156	6,789	0.065	0.188	0.629	0.564	MH-2054
1573	CBD	CBD	0.148	6,456	0.062	0.360	1.142	1.080	MH-1131
1574	LR	LR	0.307	13,389	0.128	0.219	0.785	0.657	MH-1051
1575	LR	LR	0.123	5,349	0.051	0.219	0.708	0.657	MH-1061
1576	LR	LR	0.124	5,396	0.052	0.219	0.709	0.657	MH-1051
1577	CBD	CBD	0.238	10,367	0.099	0.578	1.833	1.734	MH-1225
1578	LR	LR	0.170	7,413	0.071	0.219	0.728	0.657	MH-1119
1579	CBD	CBD	0.257	11,198	0.107	0.625	1.982	1.875	MH-1131
1580	LR	LR	0.132	5,738	0.055	0.219	0.712	0.657	MH-1061
1581	MR	MR	0.140	6,096	0.058	0.188	0.622	0.564	MH-2054
1582	LR	LR	0.164	7,156	0.068	0.219	0.725	0.657	MH-1051
1583	MR	MR	0.341	14,872	0.142	0.188	0.706	0.564	MH-2016
1584	MR	MR	0.126	5,479	0.053	0.188	0.617	0.564	MH-2054
1585	MR	MR	0.235	10,248	0.098	0.188	0.662	0.564	MH-2016
1586	MR	MR	0.124	5,422	0.052	0.188	0.616	0.564	MH-2054
1587	MR	MR	0.179	7,778	0.075	0.188	0.639	0.564	MH-2054
1588	MR	MR	0.141	6,125	0.059	0.188	0.623	0.564	MH-2054
1589	MR	MR	0.147	6,412	0.061	0.188	0.625	0.564	MH-2054
1590	MR	MR	0.169	7,366	0.070	0.188	0.634	0.564	MH-2054
1591	LR	LR	0.299	13,034	0.125	0.219	0.782	0.657	MH-1051
1592	PQP	PQP	0.312	13,610	0.130	0.758	2.404	2.274	MH-1225
1593	LR	LR	0.148	6,468	0.062	0.219	0.719	0.657	MH-1119
1594	LR	LR	0.123	5,352	0.051	0.219	0.708	0.657	MH-1061
1595	MHR	MHR	0.130	5,654	0.054	0.188	0.618	0.564	MH-2106
1596	MR	MR	0.158	6,862	0.066	0.188	0.630	0.564	MH-2054
1597	CBD	CBD	0.112	4,875	0.047	0.272	0.863	0.816	MH-1131
1598	LR	LR	0.239	10,425	0.100	0.219	0.757	0.657	MH-1119
1599	LR	LR	0.130	5,660	0.054	0.219	0.711	0.657	MH-1061
1600	LR	LR	0.198	8,623	0.083	0.219	0.740	0.657	MH-1059
1601	LR	LR	0.300	13,087	0.125	0.219	0.782	0.657	MH-1051
1602	MR	MR	0.138	6,011	0.058	0.188	0.622	0.564	MH-2054
1603	MR	MR	0.144	6,267	0.060	0.188	0.624	0.564	MH-2054
1604	CBD	CBD	0.111	4,841	0.046	0.270	0.856	0.810	MH-1131
1605	MR	MR	0.150	6,514	0.063	0.188	0.627	0.564	MH-2054
1606	MR	MR	0.175	7,623	0.073	0.188	0.637	0.564	MH-2054
1607	MR	MR	0.315	13,719	0.131	0.188	0.695	0.564	MH-2016
1608	CBD	CBD	0.152	6,631	0.063	0.369	1.170	1.107	MH-1225
1609	MR	MR	0.232	10,106	0.097	0.188	0.661	0.564	MH-2016
1610	MR	MR	0.188	8,197	0.078	0.188	0.642	0.564	MH-2054
1611	LR	LR	0.224	9,751	0.093	0.219	0.750	0.657	MH-1119
1612	CBD	CBD	0.127	5,513	0.053	0.309	0.980	0.927	MH-1131
1613	LR	LR	0.201	8,775	0.084	0.219	0.741	0.657	MH-1059
1614	LR	LR	0.260	11,304	0.108	0.219	0.765	0.657	MH-1073
1615	MHR	MHR	0.143	6,219	0.060	0.188	0.624	0.564	MH-2106
1616	LR	LR	0.172	7,477	0.072	0.219	0.729	0.657	MH-1131
1617	MR	MR	0.194	8,434	0.081	0.188	0.645	0.564	MH-2054
1618	MR	MR	0.173	7,556	0.072	0.188	0.636	0.564	MH-2054
1619	Vacant	MR	2.834	123,463	1.181	5.455	17.546	16.365	MH-1003
1620	LR	LR	0.304	13,253	0.127	0.219	0.784	0.657	MH-1051
1621	CBD	CBD	0.124	5,410	0.052	0.301	0.955	0.903	MH-1131
1622	MR	MR	0.148	6,441	0.062	0.188	0.626	0.564	MH-2054
1623	LR	LR	0.117	5,084	0.049	0.219	0.706	0.657	MH-1225
1624	LR	LR	0.159	6,926	0.066	0.219	0.723	0.657	MH-1119
1625	LR	LR	0.139	6,069	0.058	0.219	0.715	0.657	MH-1059
1626	MR	MR	0.152	6,600	0.063	0.188	0.627	0.564	MH-2054
1627	CBD	CBD	0.130	5,666	0.054	0.316	1.002	0.948	MH-1131
1628	MR	MR	0.174	7,579	0.073	0.188	0.637	0.564	MH-2054
1629	LR	LR	0.150	6,513	0.063	0.219	0.720	0.657	MH-1121
1630	LR	LR	0.122	5,295	0.051	0.219	0.708	0.657	MH-1225
1631	LR	LR	0.133	5,776	0.055	0.219	0.712	0.657	MH-1119
1632	MR	MR	0.126	5,476	0.053	0.188	0.617	0.564	MH-2054
1633	MR	MR	0.184	8,026	0.077	0.188	0.641	0.564	MH-2054
1634	MR	MR	0.140	6,107	0.058	0.188	0.622	0.564	MH-2054
1635	LR	LR	0.197	8,569	0.082	0.219	0.739	0.657	MH-1131
1636	LR	LR	0.132	5,769	0.055	0.219	0.712	0.657	MH-1059
1637	MR	MR	0.161	7,008	0.067	0.188	0.631	0.564	MH-2054
1638	MR	MR	0.246	10,703	0.103	0.188	0.667	0.564	MH-2016
1639	LR	LR	0.126	5,470	0.053	0.219	0.710	0.657	MH-1121
1640	LR	LR	0.203	8,855	0.085	0.219	0.742	0.657	MH-1225
1641	LR	LR	0.209	9,114	0.087	0.219	0.744	0.657	MH-1119
1642	MR	MR	0.166	7,252	0.069	0.188	0.633	0.564	MH-2054
1643	MHR	MHR	0.129	5,638	0.054	0.188	0.618	0.564	MH-2106
1644	LR	LR	0.137	5,954	0.057	0.219	0.714	0.657	MH-1059
1645	MR	MR	0.137	5,956	0.057	0.188	0.621	0.564	MH-2054
1646	LR	LR	0.178	7,765	0.074	0.219	0.731	0.657	MH-1225
1647	LR	LR	0.158	6,887	0.066	0.219	0.723	0.657	MH-1131
1648	MR	MR	0.154	6,729	0.064	0.188	0.628	0.564	MH-2054
1649	MR	MR	0.153	6,664	0.064	0.188	0.628	0.564	MH-2054
1650	LR	LR	0.168	7,318	0.070	0.219	0.727	0.657	MH-1121
1651	LR	LR	0.278	12,107	0.116	0.219	0.773	0.657	MH-1127

Attributes of parcel_loading_to_manhole.shp

Parcel ID	Existing Land Use	Buildout Land Use	Area (acres)	Area (ft^2)	I/I (gpm)	Buildout ADWF (gpm)	Buildout PWWF (gpm)	Buildout PDWF (gpm)	Manhole
1652	LR	LR	0.181	7,903	0.075	0.219	0.732	0.657	MH-1059
1653	LR	LR	0.287	12,485	0.120	0.219	0.777	0.657	MH-1225
1654	LR	LR	0.134	5,844	0.056	0.219	0.713	0.657	MH-1059
1655	MR	MR	0.204	8,875	0.085	0.188	0.649	0.564	MH-2054
1656	MR	MR	0.134	5,836	0.056	0.188	0.620	0.564	MH-2054
1657	MR	MR	0.138	5,994	0.058	0.188	0.622	0.564	MH-2054
1658	MR	MR	0.191	8,326	0.080	0.188	0.644	0.564	MH-2054
1659	LR	LR	0.237	10,305	0.099	0.219	0.756	0.657	MH-1131
1660	MR	MR	0.453	19,728	0.189	0.188	0.753	0.564	MH-2016
1661	LR	LR	0.181	7,883	0.075	0.219	0.732	0.657	MH-1121
1662	NC	NC	1.294	56,359	0.539	2.247	7.280	6.741	MH-1007
1663	LR	LR	0.145	6,305	0.060	0.219	0.717	0.657	MH-1059
1664	MR	MR	0.330	14,393	0.138	0.188	0.702	0.564	MH-2016
1665	LR	LR	0.197	8,582	0.082	0.219	0.739	0.657	MH-1059
1666	LR	LR	0.210	9,129	0.088	0.219	0.745	0.657	MH-1359
1667	MR	MR	0.141	6,159	0.059	0.188	0.623	0.564	MH-2054
1668	LR	LR	0.312	13,579	0.130	0.219	0.787	0.657	MH-1225
1669	MHR	MHR	0.130	5,648	0.054	0.188	0.618	0.564	MH-2106
1670	LR	LR	0.137	5,951	0.057	0.219	0.714	0.657	MH-1127
1671	LR	LR	0.308	13,419	0.128	0.219	0.785	0.657	MH-1131
1672	LR	LR	0.250	10,871	0.104	0.219	0.761	0.657	MH-1121
1673	Vacant	OS	0.497	21,653	0.207	0.000	0.207	0.000	MH-2054
1674	LR	LR	0.226	9,861	0.094	0.219	0.751	0.657	MH-1059
1675	MR	MR	0.176	7,675	0.073	0.188	0.637	0.564	MH-2054
1676	MR	MR	0.134	5,855	0.056	0.188	0.620	0.564	MH-2054
1677	LR	LR	0.180	7,842	0.075	0.219	0.732	0.657	MH-1127
1678	LR	LR	0.148	6,432	0.062	0.219	0.719	0.657	MH-1359
1679	MR	MR	0.153	6,657	0.064	0.188	0.628	0.564	MH-2054
1680	Vacant	MR	10.545	459,335	4.394	20.299	65.291	60.897	MH-1003
1681	PR	PR	3.090	134,587	1.288	0.429	1.717	0.429	MH-1123
1682	LR	LR	0.146	6,367	0.061	0.219	0.718	0.657	MH-1359
1683	MR	MR	0.146	6,359	0.061	0.188	0.625	0.564	MH-2054
1684	LR	LR	0.179	7,791	0.075	0.219	0.732	0.657	MH-1059
1685	LR	LR	0.141	6,153	0.059	0.219	0.716	0.657	MH-1127
1686	LR	LR	0.087	3,775	0.036	0.219	0.693	0.657	MH-1225
1687	LR	LR	0.086	3,767	0.036	0.219	0.693	0.657	MH-1117
1688	LR	LR	0.147	6,422	0.061	0.219	0.718	0.657	MH-1359
1689	LR	LR	0.635	27,677	0.265	0.219	0.922	0.657	MH-1127
1690	MR	MR	0.140	6,097	0.058	0.188	0.622	0.564	MH-1007
1691	LR	LR	0.183	7,984	0.076	0.219	0.733	0.657	MH-1059
1692	LR	LR	0.136	5,907	0.057	0.219	0.714	0.657	MH-1117
1693	LR	LR	0.155	6,773	0.065	0.219	0.722	0.657	MH-1127
1694	MR	MR	0.221	9,637	0.092	0.188	0.656	0.564	MH-2054
1695	LR	LR	0.176	7,672	0.073	0.219	0.730	0.657	MH-1359
1696	MR	MR	0.173	7,539	0.072	0.188	0.636	0.564	MH-2054
1697	LR	LR	0.146	6,373	0.061	0.219	0.718	0.657	MH-1359
1698	LR	LR	0.248	10,811	0.103	0.219	0.760	0.657	MH-1133
1699	MR	MR	0.144	6,270	0.060	0.188	0.624	0.564	MH-2054
1700	MR	MR	0.167	7,296	0.070	0.188	0.634	0.564	MH-2054
1701	MR	MR	0.142	6,165	0.059	0.188	0.623	0.564	MH-1007
1702	MR	MR	0.148	6,440	0.062	0.188	0.626	0.564	MH-2054
1703	LR	LR	0.221	9,648	0.092	0.219	0.749	0.657	MH-1045
1704	LR	LR	0.150	6,556	0.063	0.219	0.720	0.657	MH-1127
1705	LR	LR	0.180	7,852	0.075	0.219	0.732	0.657	MH-1359
1706	LR	LR	0.144	6,259	0.060	0.219	0.717	0.657	MH-1359
1707	LR	LR	0.100	4,372	0.042	0.219	0.699	0.657	MH-1225
1708	Vacant	NC	0.461	20,097	0.192	0.800	2.592	2.400	MH-1007
1709	MR	MR	0.242	10,563	0.101	0.188	0.665	0.564	MH-2054
1710	LR	LR	0.117	5,084	0.049	0.219	0.706	0.657	MH-1009
1711	MR	MR	0.142	6,200	0.059	0.188	0.623	0.564	MH-1007
1712	LR	LR	0.144	6,267	0.060	0.219	0.717	0.657	MH-1359
1713	LR	LR	0.135	5,892	0.056	0.219	0.713	0.657	MH-1133
1714	LR	LR	0.179	7,777	0.075	0.219	0.732	0.657	MH-1359
1715	LR	LR	0.122	5,307	0.051	0.219	0.708	0.657	MH-1009
1716	MR	MR	0.147	6,395	0.061	0.188	0.625	0.564	MH-1007
1717	LR	LR	0.148	6,450	0.062	0.219	0.719	0.657	MH-1359
1718	LR	LR	0.164	7,128	0.068	0.219	0.725	0.657	MH-1125
1719	LR	LR	0.338	14,739	0.141	0.219	0.798	0.657	MH-1133
1720	LR	LR	0.262	11,413	0.109	0.219	0.766	0.657	MH-1127
1721	Vacant	NC	0.265	11,531	0.110	0.460	1.490	1.380	MH-1007
1722	LR	LR	0.116	5,032	0.048	0.219	0.705	0.657	MH-1009
1723	LR	LR	0.153	6,671	0.064	0.219	0.721	0.657	MH-1225
1724	PR	PR	2.587	112,711	1.078	0.359	1.437	0.359	MH-2054
1725	LR	LR	0.144	6,281	0.060	0.219	0.717	0.657	MH-1359
1726	LR	LR	0.206	8,976	0.086	0.219	0.743	0.657	MH-1359
1727	MR	MR	0.168	7,326	0.070	0.188	0.634	0.564	MH-1007
1728	LR	LR	0.171	7,457	0.071	0.219	0.728	0.657	MH-1125
1729	Vacant	LR	1.313	57,207	0.547	2.097	6.838	6.291	MH-2054
1730	LR	LR	0.126	5,467	0.053	0.219	0.710	0.657	MH-1009
1731	LR	LR	0.282	12,299	0.118	0.219	0.775	0.657	MH-1225
1732	LR	LR	0.154	6,726	0.064	0.219	0.721	0.657	MH-1127
1733	LR	LR	0.160	6,960	0.067	0.219	0.724	0.657	MH-1359
1734	Vacant	MR	0.274	11,946	0.114	0.527	1.695	1.581	MH-1007
1735	LR	LR	0.100	4,349	0.042	0.219	0.699	0.657	MH-1133
1736	Vacant	NC	0.460	20,035	0.192	0.799	2.589	2.397	MH-1007
1737	MR	MR	0.152	6,602	0.063	0.188	0.627	0.564	MH-1007
1738	LR	LR	0.127	5,525	0.053	0.219	0.710	0.657	MH-1009
1739	LR	LR	0.120	5,238	0.050	0.219	0.707	0.657	MH-1125
1740	LR	LR	0.239	10,402	0.100	0.219	0.757	0.657	MH-1359
1741	LR	LR	0.220	9,604	0.092	0.219	0.749	0.657	MH-1127
1742	LR	LR	0.190	8,277	0.079	0.219	0.736	0.657	MH-1125
1743	LR	LR	0.120	5,209	0.050	0.219	0.707	0.657	MH-1009
1744	LR	LR	0.420	18,274	0.175	0.219	0.832	0.657	MH-1133
1745	LR	LR	0.138	6,027	0.058	0.219	0.715	0.657	MH-1359
1746	Vacant	NC	0.544	23,690	0.227	0.944	3.059	2.832	MH-1007
1747	LR	LR	0.185	8,054	0.077	0.219	0.734	0.657	MH-1359
1748	LR	LR	0.160	6,971	0.067	0.219	0.724	0.657	MH-1133
1749	LR	LR	0.183	7,962	0.076	0.219	0.733	0.657	MH-1359
1750	OS	OS	0.831	36,201	0.346	0.000	0.346	0.000	MH-1007
1751	LR	LR	0.237	10,339	0.099	0.219	0.756	0.657	MH-1009
1752	LR	LR	0.221	9,629	0.092	0.219	0.749	0.657	MH-1125
1753	LR	LR	0.142	6,174	0.059	0.219	0.716	0.657	MH-1359
1754	LR	LR	0.207	8,996	0.086	0.219	0.743	0.657	MH-1125
1755	LR	LR	0.128	5,577	0.053	0.219	0.710	0.657	MH-1009
1756	LR	LR	0.164	7,137	0.068	0.219	0.725	0.657	MH-1359
1757	LR	LR	0.142	6,178	0.059	0.219	0.716	0.657	MH-1359
1758	LR	LR	0.162	7,062	0.068	0.219	0.725	0.657	MH-1359
1759	LR	LR	0.181	7,867	0.075	0.219	0.732	0.657	MH-1009
1760	NC	NC	0.676	29,461	0.282	1.174	3.804	3.522	MH-1007
1761	LR	LR	0.134	5,838	0.056	0.219	0.713	0.657	MH-1009
1762	LR	LR	0.209	9,101	0.087	0.219	0.744	0.657	MH-1125
1763	LR	LR	0.158	6,870	0.066	0.219	0.723	0.657	MH-1125
1764	LR	LR	0.156	6,781	0.065	0.219	0.722	0.657	MH-1359
1765	LR	LR	0.258	11,238	0.108	0.219	0.765	0.657	MH-1047
1766	LR	LR	0.203	8,864	0.085	0.219	0.742	0.657	MH-1009
1767	LR	LR	0.142	6,193	0.059	0.219	0.716	0.657	MH-1359
1768	LR	LR	0.239	10,424	0.100	0.219	0.757	0.657	MH-1125
1769	LR	LR	0.131	5,698	0.055	0.219	0.712	0.657	MH-1009

Parcel ID	Existing Land Use	Buildout Land Use	Area (acres)	Area (ft^2)	I/I (gpm)	Buildout ADWF (gpm)	Buildout PWWF (gpm)	Buildout PDWF (gpm)	Manhole
1770	LR	LR	0.165	7,181	0.069	0.219	0.726	0.657	MH-1009
1771	LR	LR	0.224	9,752	0.093	0.219	0.750	0.657	MH-1359
1772	LR	LR	0.295	12,865	0.123	0.219	0.780	0.657	MH-1047
1773	LR	LR	0.347	15,120	0.145	0.219	0.802	0.657	MH-1225
1774	LR	LR	0.137	5,966	0.057	0.219	0.714	0.657	MH-1009
1775	PQP	PQP	0.503	21,929	0.210	0.000	0.210	0.000	MH-1045
1776	LR	LR	0.183	7,975	0.076	0.219	0.733	0.657	MH-1359
1777	LR	LR	0.132	5,742	0.055	0.219	0.712	0.657	MH-1359
1778	LR	LR	0.187	8,149	0.078	0.219	0.735	0.657	MH-1133
1779	LR	LR	0.234	10,196	0.098	0.219	0.755	0.657	MH-1125
1780	LR	LR	0.138	6,001	0.058	0.219	0.715	0.657	MH-1359
1781	LR	LR	0.164	7,130	0.068	0.219	0.725	0.657	MH-1009
1782	LR	LR	0.152	6,632	0.063	0.219	0.720	0.657	MH-1359
1783	LR	LR	0.204	8,905	0.085	0.219	0.742	0.657	MH-1009
1784	LR	LR	0.323	14,084	0.135	0.219	0.792	0.657	MH-1047
1785	LR	LR	0.162	7,053	0.068	0.219	0.725	0.657	MH-1009
1786	LR	LR	0.223	9,724	0.093	0.219	0.750	0.657	MH-1125
1787	LR	LR	0.305	13,305	0.127	0.219	0.784	0.657	MH-1011
1788	LR	LR	0.134	5,837	0.056	0.219	0.713	0.657	MH-1009
1789	LR	LR	0.126	5,478	0.053	0.219	0.710	0.657	MH-1359
1790	LR	LR	0.127	5,524	0.053	0.219	0.710	0.657	MH-1359
1791	LR	LR	0.146	6,340	0.061	0.219	0.718	0.657	MH-1359
1792	LR	LR	0.155	6,773	0.065	0.219	0.722	0.657	MH-1009
1793	LR	LR	0.158	6,877	0.066	0.219	0.723	0.657	MH-1359
1794	LR	LR	0.150	6,528	0.063	0.219	0.720	0.657	MH-1125
1795	NC	NC	1.865	81,244	0.777	3.238	10.491	9.714	MH-1007
1796	LR	LR	0.133	5,790	0.055	0.219	0.712	0.657	MH-1009
1797	LR	LR	0.246	10,718	0.103	0.219	0.760	0.657	MH-1133
1798	LR	LR	0.139	6,066	0.058	0.219	0.715	0.657	MH-1123
1799	LR	LR	0.149	6,476	0.062	0.219	0.719	0.657	MH-1011
1800	Vacant	LR	0.352	15,342	0.147	0.562	1.833	1.686	MH-1009
1801	LR	LR	0.153	6,681	0.064	0.219	0.721	0.657	MH-1047
1802	LR	LR	0.148	6,457	0.062	0.219	0.719	0.657	MH-1009
1803	LR	LR	0.168	7,299	0.070	0.219	0.727	0.657	MH-1047
1804	LR	LR	0.161	7,005	0.067	0.219	0.724	0.657	MH-1359
1805	LR	LR	0.114	4,948	0.048	0.219	0.705	0.657	MH-1123
1806	LR	LR	0.245	10,673	0.102	0.219	0.759	0.657	MH-1011
1807	LR	LR	0.161	7,013	0.067	0.219	0.724	0.657	MH-1359
1808	LR	LR	0.134	5,837	0.056	0.219	0.713	0.657	MH-1359
1809	Vacant	AG	1.022	44,506	0.426	0.000	0.426	0.000	MH-1007
1810	LR	LR	0.154	6,705	0.064	0.219	0.721	0.657	MH-1359
1811	LR	LR	0.181	7,881	0.075	0.219	0.732	0.657	MH-1047
1812	LR	LR	0.128	5,557	0.053	0.219	0.710	0.657	MH-1115
1813	LR	LR	0.153	6,670	0.064	0.219	0.721	0.657	MH-1047
1814	LR	LR	0.239	10,391	0.100	0.219	0.757	0.657	MH-1011
1815	LR	LR	0.352	15,352	0.147	0.219	0.804	0.657	MH-1047
1816	LR	LR	0.279	12,135	0.116	0.219	0.773	0.657	MH-1047
1817	LR	LR	0.127	5,523	0.053	0.219	0.710	0.657	MH-1115
1818	LR	LR	0.150	6,519	0.063	0.219	0.720	0.657	MH-1115
1819	LR	LR	0.154	6,687	0.064	0.219	0.721	0.657	MH-1047
1820	LR	LR	0.219	9,525	0.091	0.219	0.748	0.657	MH-1009
1821	LR	LR	0.143	6,243	0.060	0.219	0.717	0.657	MH-1359
1822	LR	LR	0.121	5,290	0.050	0.219	0.707	0.657	MH-1009
1823	LR	LR	0.142	6,180	0.059	0.219	0.716	0.657	MH-1359
1824	LR	LR	0.146	6,378	0.061	0.219	0.718	0.657	MH-1115
1825	LR	LR	0.146	6,377	0.061	0.219	0.718	0.657	MH-1047
1826	LR	LR	0.073	3,178	0.030	0.219	0.687	0.657	MH-1133
1827	LR	LR	0.156	6,802	0.065	0.219	0.722	0.657	MH-1011
1828	LR	LR	0.185	8,043	0.077	0.219	0.734	0.657	MH-1009
1829	LR	LR	0.144	6,292	0.060	0.219	0.717	0.657	MH-1359
1830	LR	LR	0.348	15,179	0.145	0.219	0.802	0.657	MH-1047
1831	LR	LR	0.138	6,014	0.058	0.219	0.715	0.657	MH-1359
1832	LR	LR	0.235	10,225	0.098	0.219	0.755	0.657	MH-1047
1833	LR	LR	0.220	9,575	0.092	0.219	0.749	0.657	MH-1115
1834	LR	LR	0.160	6,983	0.067	0.219	0.724	0.657	MH-1011
1835	LR	LR	0.190	8,259	0.079	0.219	0.736	0.657	MH-1009
1836	LR	LR	0.179	7,794	0.075	0.219	0.732	0.657	MH-1359
1837	LR	LR	0.187	8,147	0.078	0.219	0.735	0.657	MH-1047
1838	Vacant	AG	2.760	120,213	1.150	0.000	1.150	0.000	MH-1007
1839	LR	LR	0.157	6,844	0.065	0.219	0.722	0.657	MH-1011
1840	LR	LR	0.195	8,481	0.081	0.219	0.738	0.657	MH-1047
1841	LR	LR	0.185	8,065	0.077	0.219	0.734	0.657	MH-1011
1842	LR	LR	0.136	5,911	0.057	0.219	0.714	0.657	MH-1359
1843	LR	LR	0.178	7,734	0.074	0.219	0.731	0.657	MH-1047
1844	LR	LR	0.111	4,835	0.046	0.219	0.703	0.657	MH-1359
1845	LR	LR	0.258	11,243	0.108	0.219	0.765	0.657	MH-1011
1846	LR	LR	0.273	11,901	0.114	0.219	0.771	0.657	MH-1359
1847	LR	LR	0.192	8,363	0.080	0.219	0.737	0.657	MH-1009
1848	LR	LR	0.176	7,663	0.073	0.219	0.730	0.657	MH-1047
1849	LR	LR	0.172	7,483	0.072	0.219	0.729	0.657	MH-1047
1850	LR	LR	0.161	7,009	0.067	0.219	0.724	0.657	MH-1011
1851	LR	LR	0.185	8,058	0.077	0.219	0.734	0.657	MH-1047
1852	LR	LR	0.134	5,847	0.056	0.219	0.713	0.657	MH-1359
1853	LR	LR	0.327	14,256	0.136	0.219	0.793	0.657	MH-1011
1854	LR	LR	0.210	9,135	0.088	0.219	0.745	0.657	MH-1359
1855	LR	LR	0.171	7,463	0.071	0.219	0.728	0.657	MH-1047
1856	LR	LR	0.272	11,862	0.113	0.219	0.770	0.657	MH-1047
1857	LR	LR	0.145	6,309	0.060	0.219	0.717	0.657	MH-1011
1858	LR	LR	0.203	8,829	0.085	0.219	0.742	0.657	MH-1047
1859	LR	LR	0.155	6,738	0.065	0.219	0.722	0.657	MH-1011
1860	LR	LR	0.174	7,592	0.073	0.219	0.730	0.657	MH-1047
1861	LR	LR	0.218	9,477	0.091	0.219	0.748	0.657	MH-1047
1862	LR	LR	0.127	5,524	0.053	0.219	0.710	0.657	MH-1011
1863	LR	LR	0.228	9,950	0.095	0.219	0.752	0.657	MH-1047
1864	LR	LR	0.149	6,489	0.062	0.219	0.719	0.657	MH-1009
1865	LR	LR	0.173	7,517	0.072	0.219	0.729	0.657	MH-1047
1866	LR	LR	0.379	16,510	0.158	0.219	0.815	0.657	MH-1359
1867	LR	LR	0.133	5,786	0.055	0.219	0.712	0.657	MH-1011
1868	LR	LR	0.157	6,829	0.065	0.219	0.722	0.657	MH-1011
1869	LR	LR	0.169	7,378	0.070	0.219	0.727	0.657	MH-1047
1870	LR	LR	0.236	10,288	0.098	0.219	0.755	0.657	MH-1359
1871	LR	LR	0.200	8,716	0.083	0.219	0.740	0.657	MH-1011
1872	LR	LR	0.128	5,596	0.053	0.219	0.710	0.657	MH-1011
1873	LR	LR	0.441	19,210	0.184	0.219	0.841	0.657	MH-1047
1874	LR	LR	0.168	7,318	0.070	0.219	0.727	0.657	MH-1047
1875	LR	LR	0.197	8,595	0.082	0.219	0.739	0.657	MH-1047
1876	LR	LR	0.167	7,263	0.070	0.219	0.727	0.657	MH-1009
1877	Vacant	NC	0.196	8,532	0.082	0.340	1.102	1.020	MH-1007
1878	LR	LR	0.218	9,516	0.091	0.219	0.748	0.657	MH-1047
1879	LR	LR	0.259	11,280	0.108	0.219	0.765	0.657	MH-1047
1880	LR	LR	0.127	5,527	0.053	0.219	0.710	0.657	MH-1011
1881	LR	LR	0.157	6,850	0.065	0.219	0.722	0.657	MH-1047
1882	LR	LR	0.122	5,326	0.051	0.219	0.708	0.657	MH-1011
1883	LR	LR	0.162	7,060	0.068	0.219	0.725	0.657	MH-1047
1884	LR	LR	0.139	6,067	0.058	0.219	0.715	0.657	MH-1359
1885	LR	LR	0.095	4,142	0.040	0.219	0.697	0.657	MH-1011
1886	LR	LR	0.150	6,525	0.063	0.219	0.720	0.657	MH-1009
1887	LR	LR	0.162	7,040	0.068	0.219	0.725	0.657	MH-1047

Attributes of parcel_loading_to_manhole.shp

Parcel ID	Existing Land Use	Buildout Land Use	Area (acres)	Area (ft^2)	I/I (gpm)	Buildout ADWF (gpm)	Buildout PWWF (gpm)	Buildout PDWF (gpm)	Manhole
1888	LR	LR	0.102	4,456	0.043	0.219	0.700	0.657	MH-1011
1889	LR	LR	0.154	6,718	0.064	0.219	0.721	0.657	MH-1047
1890	LR	LR	0.201	8,749	0.084	0.219	0.741	0.657	MH-1047
1891	LR	LR	0.110	4,772	0.046	0.219	0.703	0.657	MH-1011
1892	LR	LR	0.215	9,370	0.090	0.219	0.747	0.657	MH-1047
1893	LR	LR	0.163	7,095	0.068	0.219	0.725	0.657	MH-1011
1894	LR	LR	0.256	11,170	0.107	0.219	0.764	0.657	MH-1047
1895	LR	LR	0.165	7,192	0.069	0.219	0.726	0.657	MH-1009
1896	LR	LR	0.157	6,851	0.065	0.219	0.722	0.657	MH-1047
1897	LR	LR	0.133	5,815	0.055	0.219	0.712	0.657	MH-1009
1898	Vacant	LR	0.591	25,762	0.246	0.944	3.078	2.832	MH-1047
1899	LR	LR	0.212	9,221	0.088	0.219	0.745	0.657	MH-1009
1900	LR	LR	0.151	6,597	0.063	0.219	0.720	0.657	MH-1047
1901	LR	LR	0.382	16,639	0.159	0.219	0.816	0.657	MH-1009
1902	LR	LR	0.187	8,139	0.078	0.219	0.735	0.657	MH-1047
1903	LR	LR	0.117	5,098	0.049	0.219	0.706	0.657	MH-1011
1904	LR	LR	0.145	6,301	0.060	0.219	0.717	0.657	MH-1047
1905	LR	LR	0.149	6,493	0.062	0.219	0.719	0.657	MH-1047
1906	LR	LR	0.161	6,994	0.067	0.219	0.724	0.657	MH-1011
1907	LR	LR	0.200	8,708	0.083	0.219	0.740	0.657	MH-1047
1908	LR	LR	0.241	10,484	0.100	0.219	0.757	0.657	MH-1011
1909	LR	LR	0.143	6,238	0.060	0.219	0.717	0.657	MH-1047
1910	LR	LR	0.214	9,302	0.089	0.219	0.746	0.657	MH-1047
1911	LR	LR	0.149	6,507	0.062	0.219	0.719	0.657	MH-1047
1912	LR	LR	0.281	12,238	0.117	0.219	0.774	0.657	MH-1047
1913	LR	LR	0.159	6,917	0.066	0.219	0.723	0.657	MH-1009
1914	LR	LR	0.255	11,107	0.106	0.219	0.763	0.657	MH-1009
1915	LR	LR	0.338	14,723	0.141	0.219	0.798	0.657	MH-1047
1916	LR	LR	0.312	13,591	0.130	0.219	0.787	0.657	MH-1009
1917	LR	LR	0.219	9,553	0.091	0.219	0.748	0.657	MH-1047
1918	LR	LR	0.219	9,555	0.091	0.219	0.748	0.657	MH-1047
1919	LR	LR	0.361	15,731	0.150	0.219	0.807	0.657	MH-1047
1920	LR	LR	0.221	9,617	0.092	0.219	0.749	0.657	MH-1047
1921	LR	LR	0.194	8,440	0.081	0.219	0.738	0.657	MH-1047
1922	LR	LR	0.322	14,037	0.134	0.219	0.791	0.657	MH-1009
1923	LR	LR	0.233	10,165	0.097	0.219	0.754	0.657	MH-1047
1924	LR	LR	0.246	10,694	0.103	0.219	0.760	0.657	MH-1047
1925	LR	LR	0.177	7,690	0.074	0.219	0.731	0.657	MH-1047
1926	LR	LR	0.232	10,086	0.097	0.219	0.754	0.657	MH-1047
1927	LR	LR	0.308	13,416	0.128	0.219	0.785	0.657	MH-1047
1928	LR	LR	0.259	11,298	0.108	0.219	0.765	0.657	MH-1009
1929	LR	LR	0.212	9,215	0.088	0.219	0.745	0.657	MH-1009
1930	LR	LR	0.477	20,784	0.199	0.219	0.856	0.657	MH-1047
1931	LR	LR	0.197	8,587	0.082	0.219	0.739	0.657	MH-1047
1932	LR	LR	0.178	7,744	0.074	0.219	0.731	0.657	MH-1009
1933	LR	LR	0.179	7,785	0.075	0.219	0.732	0.657	MH-1047
1934	LR	LR	0.471	20,517	0.196	0.219	0.853	0.657	MH-1047
1935	LR	LR	0.231	10,071	0.096	0.219	0.753	0.657	MH-1047
1936	LR	LR	0.322	14,027	0.134	0.219	0.791	0.657	MH-1047
1937	LR	LR	0.214	9,317	0.089	0.219	0.746	0.657	MH-1009
1938	LR	LR	0.326	14,187	0.136	0.219	0.793	0.657	MH-1047
1939	LR	LR	0.244	10,648	0.102	0.219	0.759	0.657	MH-1047
1940	LR	LR	0.217	9,451	0.090	0.219	0.747	0.657	MH-1047
1941	LR	LR	0.422	18,387	0.176	0.219	0.833	0.657	MH-1009
1942	LR	LR	0.207	8,997	0.086	0.219	0.743	0.657	MH-1047
1943	LR	LR	0.205	8,950	0.085	0.219	0.742	0.657	MH-1047
1944	LR	LR	0.233	10,171	0.097	0.219	0.754	0.657	MH-1009
1945	LR	LR	0.698	30,393	0.291	0.219	0.948	0.657	MH-1047
1946	LR	LR	0.189	8,231	0.079	0.219	0.736	0.657	MH-1047
1947	LR	LR	0.357	15,534	0.149	0.219	0.806	0.657	MH-1009
1948	LR	LR	0.179	7,816	0.075	0.219	0.732	0.657	MH-1047
1949	LR	LR	0.255	11,125	0.106	0.219	0.763	0.657	MH-1047
1950	LR	LR	0.156	6,788	0.065	0.219	0.722	0.657	MH-1047
1951	LR	LR	0.208	9,079	0.087	0.219	0.744	0.657	MH-1047
1952	LR	LR	0.149	6,488	0.062	0.219	0.719	0.657	MH-1047
1953	LR	LR	0.136	5,922	0.057	0.219	0.714	0.657	MH-1047
1954	LR	LR	0.113	4,908	0.047	0.219	0.704	0.657	MH-1047
1955	LR	LR	0.314	13,695	0.131	0.219	0.788	0.657	MH-1047
1956	LR	LR	0.438	19,089	0.183	0.219	0.840	0.657	MH-1047
1957	LR	LR	0.247	10,744	0.103	0.219	0.760	0.657	MH-1047
1958	LR	LR	0.549	23,897	0.229	0.219	0.886	0.657	MH-1047
1959	Vacant	LR	0.580	25,249	0.242	0.926	3.020	2.778	MH-1047
1960	LR	LR	0.604	26,315	0.252	0.219	0.909	0.657	MH-1047
1961	LR	LR	0.402	17,528	0.168	0.219	0.825	0.657	MH-1047
1962	Vacant	LI	4.651	202,619	1.938	6.460	21.318	19.380	MH-30094
1963	Vacant	PC/BP	40.493	1,763,867	16.873	70.300	227.773	210.900	MH-30006
1964	HR	HR	2.707	117,911	1.128	5.132	16.524	15.396	MH-1181
1965	PQP	PQP	3.682	160,384	1.534	0.000	1.534	0.000	MH-1163
1966	Vacant	LR	4.384	190,969	1.827	7.002	22.833	21.006	MH-1047
1967	Vacant	LR	0.868	37,812	0.362	1.386	4.520	4.158	MH-1133
1968	Vacant	LR	6.032	262,736	2.514	9.634	31.416	28.902	MH-1047
1969	Vacant	LR	1.691	73,641	0.705	2.701	8.808	8.103	MH-1047
1970	Vacant	LR	1.447	63,025	0.603	2.311	7.536	6.933	MH-1047
1971	Vacant	LR	1.560	67,969	0.650	2.492	8.126	7.476	MH-1047
1972	MR	MR	0.225	9,781	0.094	0.188	0.658	0.564	MH-1279
1973	MR	MR	0.250	10,903	0.104	0.188	0.668	0.564	MH-1279
1974	Vacant	MR	0.239	10,403	0.100	0.460	1.480	1.380	MH-1259
1975	Vacant	MR	0.242	10,523	0.101	0.466	1.499	1.398	MH-1259
1976	MR	MR	0.218	9,517	0.091	0.188	0.655	0.564	MH-1259
1977	MR	MR	0.211	9,212	0.088	0.188	0.652	0.564	MH-1259
1978	Vacant	MR	0.217	9,439	0.090	0.418	1.344	1.254	MH-1259
1979	MR	MR	0.208	9,069	0.087	0.188	0.651	0.564	MH-1259
1980	MR	MR	0.195	8,504	0.081	0.188	0.645	0.564	MH-1259
1981	MR	MR	0.184	8,035	0.077	0.188	0.641	0.564	MH-1259
1982	MR	MR	0.172	7,504	0.072	0.188	0.636	0.564	MH-1259
1983	MR	MR	0.169	7,346	0.070	0.188	0.634	0.564	MH-1259
1984	MR	MR	0.170	7,426	0.071	0.188	0.635	0.564	MH-1259
1985	MR	MR	0.170	7,420	0.071	0.188	0.635	0.564	MH-1259
1986	MR	MR	0.172	7,505	0.072	0.188	0.636	0.564	MH-1259
1987	MR	MR	0.159	6,921	0.066	0.188	0.630	0.564	MH-1259
1988	MR	MR	0.249	10,867	0.104	0.188	0.668	0.564	MH-1259
1989	MR	MR	0.332	14,445	0.138	0.188	0.702	0.564	MH-1249
1990	MR	MR	0.224	9,752	0.093	0.188	0.657	0.564	MH-1249
1991	Vacant	PC/BP	9.434	410,966	3.931	16.378	53.065	49.134	MH-30006
1992	OS	OS	6.296	274,252	2.624	0.000	2.624	0.000	MH-30006
1993	OS	OS	5.071	220,890	2.113	0.000	2.113	0.000	MH-1259
1994	OS	OS	7.109	309,679	2.962	0.000	2.962	0.000	MH-1259
1995	Vacant	LR	1.196	52,077	0.498	1.910	6.228	5.730	MH-1225
1996	OS	OS	26.839	1,169,104	11.184	0.000	11.184	0.000	MH-1133
1997	OS	OS	3.011	131,162	1.255	0.000	1.255	0.000	MH-1243
1998	Vacant	RR	19.831	863,817	8.264	4.338	12.602	13.014	MH-30252
1999	Vacant	RR	27.111	1,180,972	11.297	5.931	17.228	17.793	MH-30252
2000	Vacant	PQP	30.455	1,326,608	12.691	3.125	22.066	9.375	MH-30252
2001	Vacant	PR	13.236	576,547	5.515	1.838	7.353	1.838	MH-30252
2002	LR	LR	2.350	102,374	0.979	3.753	12.238	11.259	MH-2174
2003	Vacant	LR	3.475	151,374	1.448	5.549	18.095	16.647	MH-30252
2004	Vacant	OS	56.008	2,439,727	23.339	0.000	23.339	0.000	MH-30072
2005	Vacant	HSC	1.247	54,321	0.520	2.165	7.015	6.495	MH-30094

Attributes of parcel_loading_to_manhole.shp

Parcel ID	Existing Land Use	Buildout Land Use	Area (acres)	Area (ft^2)	I/I (gpm)	Buildout ADWF (gpm)	Buildout PWWF (gpm)	Buildout PDWF (gpm)	Manhole
2006	Vacant	PR	2.919	127,167	1.216	0.405	1.621	0.405	MH-30074
2007	Vacant	OS	39.892	1,737,681	16.623	0.000	16.623	0.000	MH-30062
2008	Vacant	NC	6.070	264,413	2.529	10.538	34.143	31.614	MH-30060
2009	Vacant	LI	3.416	148,795	1.423	4.744	15.655	14.232	MH-30060
2010	Vacant	LI	2.883	125,591	1.201	4.004	13.213	12.012	MH-30060
2011	Vacant	PQP	5.231	227,855	2.180	2.307	9.101	6.921	MH-2188
2012	Vacant	HR	5.229	227,779	2.179	19.609	61.006	58.827	MH-30116
2013	Vacant	HR	1.127	49,089	0.470	4.226	13.148	12.678	MH-30120
2014	HSC	HSC	0.844	36,776	0.352	1.465	4.747	4.395	MH-30094
2015	Vacant	CBD	5.119	223,001	2.133	12.442	39.459	37.326	MH-2262
2016	Vacant	LI	6.771	294,933	2.821	9.404	31.033	28.212	MH-30084
2017	Vacant	LR	24.765	1,078,768	10.320	39.555	128.985	118.665	MH-30082
2018	Vacant	LR	10.102	440,042	4.210	16.135	52.615	48.405	MH-2262
2019	MR	MR	0.166	7,251	0.069	0.188	0.633	0.564	MH-2262
2020	MR	MR	0.169	7,361	0.070	0.188	0.634	0.564	MH-2262
2021	MR	MR	0.169	7,373	0.070	0.188	0.634	0.564	MH-2262
2022	MR	MR	0.170	7,397	0.071	0.188	0.635	0.564	MH-2262
2023	MR	MR	0.173	7,541	0.072	0.188	0.636	0.564	MH-2262
2024	MR	MR	0.193	8,397	0.080	0.188	0.644	0.564	MH-2262
2025	MR	MR	0.200	8,732	0.083	0.188	0.647	0.564	MH-2262
2026	MR	MR	0.227	9,876	0.095	0.188	0.659	0.564	MH-2262
2027	Vacant	PC	6.018	262,130	2.508	10.448	33.852	31.344	MH-30104
2028	Vacant	OS	13.364	582,132	5.569	0.000	5.569	0.000	MH-30084
2029	LR	LR	0.731	31,852	0.305	0.219	0.962	0.657	MH-1047
2030	Vacant	PR	4.808	209,437	2.003	0.668	2.671	0.668	MH-30116
2031	LR	LR	0.339	14,773	0.141	0.219	0.798	0.657	MH-1133
2032	Vacant	MR	1.250	54,450	0.521	2.188	7.085	6.564	MH-30252
2033	Vacant	MR	4.388	191,143	1.828	6.781	22.171	20.343	MH-30252
2034	Vacant	LR	2.707	117,925	1.128	3.719	12.285	11.157	MH-30252
2035	Vacant	MR	1.853	80,719	0.772	3.281	10.615	9.843	MH-30252
2036	Vacant	LR	2.874	125,186	1.198	4.813	15.637	14.439	MH-30252
2037	Vacant	MR	2.085	90,838	0.869	3.719	12.026	11.157	MH-30252
2038	Vacant	LR	1.858	80,926	0.774	2.967	9.675	8.901	MH-2346
2039	MR	MR	0.242	10,549	0.101	0.188	0.665	0.564	MH-2094
2040	MR	MR	0.207	9,032	0.086	0.188	0.650	0.564	MH-2094
2041	MR	MR	0.174	7,589	0.073	0.188	0.637	0.564	MH-2094
2042	MR	MR	0.169	7,357	0.070	0.188	0.634	0.564	MH-2094
2043	MR	MR	0.211	9,183	0.088	0.188	0.652	0.564	MH-2094
2044	MR	MR	0.373	16,227	0.147	0.188	0.711	0.564	MH-2094
2045	MR	MR	0.213	9,285	0.089	0.188	0.653	0.564	MH-2094
2046	MR	MR	0.134	5,829	0.056	0.188	0.620	0.564	MH-2094
2047	MR	MR	0.129	5,628	0.054	0.188	0.618	0.564	MH-2094
2048	MR	MR	0.147	6,425	0.061	0.188	0.625	0.564	MH-2094
2049	MR	MR	0.133	5,805	0.055	0.188	0.619	0.564	MH-2094
2050	MR	MR	0.144	6,274	0.060	0.188	0.624	0.564	MH-2094
2051	MR	MR	0.141	6,142	0.059	0.188	0.623	0.564	MH-2094
2052	MR	MR	0.144	6,271	0.060	0.188	0.624	0.564	MH-2094
2053	MR	MR	0.135	5,862	0.056	0.188	0.620	0.564	MH-2094
2054	MR	MR	0.142	6,178	0.059	0.188	0.623	0.564	MH-2094
2055	MR	MR	0.144	6,263	0.060	0.188	0.624	0.564	MH-2094
2056	MR	MR	0.141	6,131	0.059	0.188	0.623	0.564	MH-2094
2057	MR	MR	0.142	6,192	0.059	0.188	0.623	0.564	MH-2094
2058	MR	MR	0.169	7,350	0.070	0.188	0.634	0.564	MH-2094
2059	MR	MR	0.153	6,683	0.064	0.188	0.628	0.564	MH-2094
2060	MR	MR	0.201	8,772	0.084	0.188	0.648	0.564	MH-2094
2061	MR	MR	0.143	6,211	0.060	0.188	0.624	0.564	MH-2094
2062	MR	MR	0.172	7,495	0.072	0.188	0.636	0.564	MH-2094
2063	MR	MR	0.200	8,727	0.083	0.188	0.647	0.564	MH-2094
2064	MR	MR	0.172	7,472	0.072	0.188	0.636	0.564	MH-2094
2065	Vacant	LR	2.797	121,816	1.165	3.938	12.979	11.814	MH-2346
2066	Vacant	LR	3.101	135,062	1.292	3.938	13.106	11.814	MH-2346
2067	Vacant	LR	4.607	200,687	1.920	5.688	18.984	17.064	MH-30252
2068	Vacant	LR	3.316	144,461	1.382	5.031	16.475	15.093	MH-30252
2069	Vacant	LR	5.216	227,220	2.173	6.781	22.516	20.343	MH-30252
2070	Vacant	LR	2.154	93,807	0.897	3.063	10.086	9.189	MH-30252
2071	Vacant	LR	24.443	1,064,742	10.140	38.865	126.735	116.595	MH-30034
2072	Vacant	LR	2.827	123,134	1.178	4.514	14.720	13.542	MH-30252
2073	Vacant	LR	1.247	54,303	0.520	1.531	5.113	4.593	MH-30252
2074	Vacant	MHR	1.080	47,037	0.450	2.025	6.525	6.075	MH-2346
2075	PQP	PQP	12.384	539,439	5.160	12.500	42.660	37.500	MH-2354
2076	Vacant	MHR	1.633	71,148	0.680	3.062	9.866	9.186	MH-2346
2077	MHR	MHR	7.335	319,514	3.120	8.563	28.809	25.689	MH-2084
2078	Vacant	LR	2.786	121,375	1.161	2.188	7.725	6.564	MH-30252
2079	Vacant	LR	2.786	121,375	1.161	2.625	9.036	7.875	MH-30252
2080	Vacant	MR	1.247	54,300	0.520	1.750	5.770	5.250	MH-30252
2081	Vacant	LR	3.876	168,850	1.615	4.375	14.740	13.125	MH-30252
2082	Vacant	LR	2.097	91,348	0.874	3.281	10.717	9.843	MH-30252
2083	Vacant	LR	2.607	113,546	1.086	3.938	12.900	11.814	MH-30252
2084	Vacant	LR	2.607	113,546	1.086	3.938	12.900	11.814	MH-30252
2085	Vacant	LR	2.239	97,514	0.933	2.625	8.808	7.875	MH-30252
2086	Vacant	LR	1.054	45,934	0.439	1.313	4.378	3.939	MH-30252
2087	MR	MR	0.173	7,524	0.072	0.188	0.636	0.564	MH-2094
2088	Vacant	LR	2.698	117,504	1.124	3.500	11.624	10.500	MH-30252
2089	Vacant	PR	8.920	388,565	3.717	1.239	4.956	1.239	MH-2354
2090	Vacant	MR	1.006	43,817	0.419	1.531	5.012	4.593	MH-30252
2091	Vacant	LR	2.926	127,459	1.219	2.406	8.437	7.218	MH-30252
2092	Vacant	LR	1.231	53,623	0.513	1.969	6.420	5.907	MH-30252
2093	Vacant	MR	3.213	139,961	1.339	5.250	17.089	15.750	MH-30252
2094	Vacant	LR	3.234	140,862	1.348	5.165	16.843	15.495	MH-30132
2095	Vacant	MHR	7.793	339,477	3.227	14.522	46.793	43.566	MH-30080

Pipe ID	Upstream Invert (ft)	Downstream Invert (ft)	Length (ft)	Diameter (in)	Roughness Coefficient	Upstream Manhole	Downstream Manhole
SP-1002	134.500	132.600	482	10	0.013	MH-1005	MH-1003
SP-1004	132.600	131.000	404	10	0.013	MH-1003	MH-1039
SP-1032	134.050	129.900	553	6	0.013	MH-1011	MH-1115
SP-1034	134.050	131.580	494	6	0.013	MH-1009	MH-1117
SP-1036	133.100	130.010	553	6	0.013	MH-1359	MH-1119
SP-1038	129.900	129.200	260	6	0.013	MH-1115	MH-1123
SP-1040	129.200	127.920	313	6	0.013	MH-1123	MH-1045
SP-1042	129.920	129.400	151	6	0.013	MH-1045	MH-1059
SP-1044	131.580	130.370	301	6	0.013	MH-1117	MH-1121
SP-1046	130.370	129.100	310	6	0.013	MH-1121	MH-1061
SP-1048	130.000	128.410	568	6	0.013	MH-1119	MH-1073
SP-1054	128.400	125.660	467	6	0.013	MH-1073	MH-1055
SP-1060	129.100	126.820	466	6	0.013	MH-1061	MH-1049
SP-1066	125.600	123.130	469	6	0.013	MH-1055	MH-1145
SP-1068	126.820	124.531	467	6	0.013	MH-1049	MH-1141
SP-1074	124.320	121.830	470	8	0.013	MH-1079	MH-1137
SP-1078	123.100	120.330	468	6	0.013	MH-1145	MH-1217
SP-1080	120.300	117.500	464	6	0.013	MH-1217	MH-1201
SP-1082	121.810	119.600	471	6	0.013	MH-1137	MH-1215
SP-1084	124.530	120.430	466	6	0.013	MH-1141	MH-1219
SP-1086	122.830	120.830	469	6	0.013	MH-1129	MH-1221
SP-1088	120.830	120.320	165	10	0.013	MH-1221	MH-1219
SP-1112	129.750	127.610	411	6	0.013	MH-1125	MH-1127
SP-1114	126.430	124.340	464	6	0.013	MH-1047	MH-1133
SP-1116	127.610	124.870	464	6	0.013	MH-1127	MH-1131
SP-1118	125.560	123.280	466	6	0.013	MH-1059	MH-1051
SP-1120	123.280	122.830	461	6	0.013	MH-1051	MH-1129
SP-1124	124.340	122.480	465	6	0.013	MH-1133	MH-1225
SP-1132	122.480	121.980	151	6	0.013	MH-1225	MH-1223
SP-1134	124.870	121.980	466	6	0.013	MH-1131	MH-1223
SP-1138	121.980	120.830	334	8	0.013	MH-1223	MH-1221
SP-1142	120.290	118.560	467	10	0.013	MH-1219	MH-1203
SP-1146	118.570	117.720	303	18	0.013	MH-1203	MH-1201
SP-1148	117.300	116.910	307	18	0.013	MH-1201	MH-1199
SP-1150	116.960	116.050	338	18	0.013	MH-1199	MH-1157
SP-1152	119.580	117.410	461	6	0.013	MH-1215	MH-1199
SP-1156	121.630	120.351	512	12	0.013	MH-1245	MH-1209
SP-1172	112.960	112.460	185	18	0.013	MH-1165	MH-1243
SP-1174	113.140	113.025	50	18	0.013	MH-1163	MH-1165
SP-1176	113.709	113.147	312	18	0.013	MH-1209	MH-1163
SP-1178	114.115	113.710	311	18	0.013	MH-1207	MH-1209
SP-1180	114.390	114.120	305	18	0.013	MH-1205	MH-1207
SP-1182	114.800	114.410	305	18	0.013	MH-1191	MH-1205
SP-1184	120.110	119.410	285	10	0.013	MH-1343	MH-1697
SP-1192	118.910	118.670	261	12	0.013	MH-1315	MH-1277
SP-1218	118.670	118.180	171	12	0.013	MH-1277	MH-1357
SP-1220	118.180	117.880	182	12	0.013	MH-1357	MH-1279
SP-1230	117.880	117.610	115	12	0.013	MH-1279	MH-1285
SP-1242	117.610	117.460	144	12	0.013	MH-1285	MH-1259
SP-1262	117.170	115.940	325	8	0.013	MH-1183	MH-1169
SP-1268	117.460	116.810	282	12	0.013	MH-1259	MH-1249
SP-1276	116.810	116.490	127	12	0.013	MH-1249	MH-1247
SP-1278	116.490	116.230	101	12	0.013	MH-1247	MH-1169
SP-1280	115.580	114.864	356	10	0.013	MH-1169	MH-1171
SP-1282	114.860	114.622	121	10	0.013	MH-1171	MH-1175
SP-1284	114.620	114.152	235	10	0.013	MH-1175	MH-1181
SP-1286	114.150	113.640	256	10	0.013	MH-1181	MH-1165
SP-1288	131.000	130.290	285	10	0.013	MH-1039	MH-1353
SP-1290	130.290	130.180	330	10	0.013	MH-1353	MH-1351
SP-1292	130.180	125.560	1,038	10	0.013	MH-1351	MH-1075
SP-1294	125.560	124.590	219	10	0.013	MH-1075	MH-1093
SP-1296	124.550	124.445	29	10	0.013	MH-1093	MH-1091
SP-1298	126.930	124.700	30	8	0.013	MH-1089	MH-1091
SP-1300	124.440	123.870	221	10	0.013	MH-1091	MH-1097

Pipe ID	Upstream Invert (ft)	Downstream Invert (ft)	Length (ft)	Diameter (in)	Roughness Coefficient	Upstream Manhole	Downstream Manhole
SP-1302	123.860	122.210	472	10	0.013	MH-1097	MH-1149
SP-1306	122.200	120.541	474	10	0.013	MH-1149	MH-1161
SP-1308	120.540	119.040	429	10	0.013	MH-1161	MH-1155
SP-1310	119.030	118.890	41	10	0.013	MH-1155	MH-1157
SP-1312	116.000	115.473	439	18	0.013	MH-1157	MH-1193
SP-1314	115.470	115.040	315	18	0.013	MH-1193	MH-1189
SP-1316	115.030	114.890	101	18	0.013	MH-1189	MH-1191
SP-1318	136.500	136.435	35	8	0.013	MH-1007	MH-1005
SP-1320	136.530	135.430	499	8	0.013	MH-1007	MH-1001
SP-1322	135.440	134.430	529	8	0.013	MH-1001	MH-1355
SP-1324	134.450	133.380	510	8	0.013	MH-1355	MH-1349
SP-1326	133.120	131.370	240	8	0.013	MH-1349	MH-1347
SP-1328	131.360	128.174	778	8	0.013	MH-1347	MH-1081
SP-1330	128.170	126.970	251	8	0.013	MH-1081	MH-1089
SP-1332	128.170	125.560	30	6	0.013	MH-1081	MH-1075
SP-1334	127.070	126.002	218	8	0.013	MH-1089	MH-1095
SP-1336	126.000	124.910	210	8	0.013	MH-1095	MH-1153
SP-1338	124.900	123.540	273	8	0.013	MH-1153	MH-1147
SP-1340	123.530	121.160	474	8	0.013	MH-1147	MH-1159
SP-1342	121.160	119.470	457	8	0.013	MH-1159	MH-1157
SP-1344	123.540	122.210	30	6	0.013	MH-1147	MH-1149
SP-1346	120.400	118.400	330	8	0.013	MH-1185	MH-1187
SP-1348	118.400	115.900	194	8	0.013	MH-1187	MH-1191
SP-2002	147.290	146.190	275	8	0.013	MH-2060	MH-2062
SP-2004	146.190	145.470	224	8	0.013	MH-2062	MH-2064
SP-2006	145.470	144.840	197	8	0.013	MH-2064	MH-2028
SP-2020	144.840	143.930	261	8	0.013	MH-2028	MH-2016
SP-2056	143.930	143.690	79	8	0.013	MH-2016	MH-2088
SP-2058	143.690	142.500	382	8	0.013	MH-2088	MH-2090
SP-2060	142.500	141.000	498	8	0.013	MH-2090	MH-2092
SP-2062	141.000	139.400	461	8	0.013	MH-2092	MH-2094
SP-2088	139.400	139.100	120	8	0.013	MH-2094	MH-2082
SP-2090	139.100	138.390	125	8	0.013	MH-2082	MH-2084
SP-2092	138.390	137.750	320	8	0.013	MH-2084	MH-2106
SP-2094	137.750	136.910	420	8	0.013	MH-2106	MH-2052
SP-2100	136.910	136.700	105	8	0.013	MH-2052	MH-2054
SP-2104	136.700	136.500	136	8	0.013	MH-2054	MH-1007
SP-2106	127.340	125.890	410	8	0.013	MH-2346	MH-30252
SP-2108	130.180	127.440	366	8	0.013	MH-2342	MH-2346
SP-2112	131.590	130.280	375	8	0.013	MH-2340	MH-2342
SP-2154	133.690	131.690	400	8	0.013	MH-2302	MH-2340
SP-2156	120.490	120.090	115	8	0.013	MH-2298	WW-1003
SP-2158	117.000	137.000	3,640	8	100.000	MH-2300	MH-2302
SP-2162	133.690	131.450	45	10	0.013	MH-2302	MH-1693
SP-2170	131.640	131.100	270	6	0.013	MH-2174	MH-2172
SP-2172	131.100	130.560	280	6	0.013	MH-2172	MH-2164
SP-2174	130.560	128.670	265	8	0.013	MH-2164	MH-2170
SP-2176	128.670	122.860	261	8	0.013	MH-2170	MH-2142
SP-2178	127.500	124.910	697	6	0.013	MH-2366	MH-1153
SP-2180	127.500	122.860	660	6	0.013	MH-2366	MH-2142
SP-2184	140.380	135.890	175	10	0.013	MH-2354	MH-2352
SP-2186	135.890	132.960	142	10	0.013	MH-2352	MH-2350
SP-2188	132.960	132.190	133	8	0.013	MH-2350	MH-2344
SP-2196	131.590	130.230	365	8	0.013	MH-2178	MH-2282
SP-2200	130.130	129.620	136	8	0.013	MH-2282	MH-2206
SP-2202	129.520	127.804	207	8	0.013	MH-2206	MH-2188
SP-2204	127.800	127.076	485	6	0.013	MH-2188	MH-2192
SP-2206	127.070	125.542	350	6	0.013	MH-2192	MH-2210
SP-2208	125.540	125.060	110	6	0.013	MH-2210	MH-2194
SP-2226	125.050	124.342	163	8	0.013	MH-2194	MH-2154
SP-2228	124.340	124.000	171	8	0.013	MH-2154	MH-2150
SP-2238	123.990	123.450	272	8	0.013	MH-2150	MH-2146
SP-2240	123.450	122.860	246	8	0.013	MH-2146	MH-2142
SP-2242	122.860	121.280	479	8	0.013	MH-2142	MH-2136

Pipe ID	Upstream Invert (ft)	Downstream Invert (ft)	Length (ft)	Diameter (in)	Roughness Coefficient	Upstream Manhole	Downstream Manhole
SP-2274	121.280	121.220	19	8	0.013	MH-2136	MH-2138
SP-2276	121.220	120.170	284	8	0.013	MH-2138	MH-2134
SP-2284	120.166	119.770	110	8	0.013	MH-2134	MH-2126
SP-2292	118.800	116.860	571	8	0.013	MH-2124	MH-2120
SP-2294	116.850	116.300	251	12	0.013	MH-2120	MH-1157
SP-2332	119.880	118.400	505	8	0.013	MH-2262	MH-1187
SP-1001	112.460	109.800	35	18	0.013	MH-1243	MH-30136
SP-1003	131.280	131.000	70	10	0.013	MH-1693	MH-1039
SP-1005	132.190	131.710	133	8	0.013	MH-2344	MH-2178
SP-1007	119.410	118.910	95	10	0.013	MH-1697	MH-1315
SP-1009	119.767	118.800	403	8	0.013	MH-2126	MH-2124
SP-30001	119.000	115.930	511	8	0.013	MH-30010	MH-30006
SP-30003	104.350	101.340	502	12	0.013	MH-30012	WW-30000
SP-30007	115.900	113.710	363	8	0.013	MH-30006	WW-30000
SP-30009	120.790	120.440	139	12	0.013	MH-30004	MH-30002
SP-30011	120.440	119.720	293	12	0.013	MH-30002	MH-30000
SP-30013	119.720	119.170	234	12	0.013	MH-30000	MH-1315
SP-30015	102.000	120.790	363	8	100.000	MH-30014	MH-30004
SP-30017	118.066	117.219	339	10	0.013	MH-30018	MH-30016
SP-30019	117.219	115.697	609	10	0.013	MH-30016	MH-1189
SP-30021	124.390	121.900	626	15	0.013	MH-30024	MH-30026
SP-30023	121.900	119.120	652	15	0.013	MH-30026	MH-30020
SP-30025	115.300	114.370	661	24	0.013	MH-30022	MH-30020
SP-30027	139.010	137.940	434	10	0.013	MH-30028	MH-30030
SP-30031	132.030	129.310	818	8	0.013	MH-30034	MH-30036
SP-30033	129.310	128.060	378	8	0.013	MH-30036	MH-30038
SP-30035	128.060	125.630	731	8	0.013	MH-30038	MH-30040
SP-30037	125.630	124.020	654	10	0.013	MH-30040	MH-30282
SP-30039	138.000	135.600	796	12	0.013	MH-30042	MH-30044
SP-30041	135.570	131.190	627	15	0.013	MH-30044	MH-30112
SP-30049	143.000	141.290	513	8	0.013	MH-30052	MH-30050
SP-30051	141.290	139.010	686	8	0.013	MH-30050	MH-30028
SP-30053	141.000	134.370	1,102	8	0.013	MH-30054	MH-30056
SP-30055	134.360	128.240	1,018	8	0.013	MH-30056	MH-30058
SP-30057	128.230	123.910	720	8	0.013	MH-30058	MH-30060
SP-30059	121.500	119.120	881	8	0.013	MH-30062	MH-30060
SP-30061	123.000	121.600	485	8	0.013	MH-30096	MH-30062
SP-30063	122.500	120.500	741	8	0.013	MH-30064	MH-30282
SP-30067	119.100	116.680	692	10	0.013	MH-30060	MH-30068
SP-30069	116.680	112.250	1,265	12	0.013	MH-30068	MH-30072
SP-30071	112.200	108.000	1,184	12	0.013	MH-30072	MH-30074
SP-30077	102.300	101.950	144	15	0.013	MH-30078	MH-30106
SP-30079	120.500	117.960	1,031	10	0.013	MH-30282	MH-30080
SP-30081	120.000	114.100	982	8	0.013	MH-30082	MH-30078
SP-30083	114.900	111.820	513	8	0.013	MH-30084	MH-30086
SP-30085	104.900	102.330	952	15	0.013	MH-30086	MH-30078
SP-30087	116.500	113.870	711	8	0.013	MH-30088	MH-30090
SP-30089	113.850	110.330	953	10	0.013	MH-30090	MH-30092
SP-30091	110.300	108.450	496	10	0.013	MH-30092	MH-30094
SP-30093	108.400	104.900	992	10	0.013	MH-30094	MH-30086
SP-30097	134.510	132.030	746	8	0.013	MH-30032	MH-30034
SP-30099	107.900	107.130	217	12	0.013	MH-30074	MH-30098
SP-30101	107.100	105.400	475	12	0.013	MH-30098	MH-30106
SP-30103	117.960	114.990	1,534	12	0.013	MH-30080	MH-30102
SP-30105	119.000	114.920	680	8	0.013	MH-30104	MH-30084
SP-30109	101.900	101.600	113	18	0.013	MH-30106	MH-30284
SP-30111	131.180	129.050	535	15	0.013	MH-30112	MH-30110
SP-30113	129.040	126.370	720	15	0.013	MH-30110	MH-30108
SP-30115	126.370	124.390	496	15	0.013	MH-30108	MH-30024
SP-30117	122.580	121.630	377	10	0.013	MH-30114	MH-1245
SP-30119	118.400	113.150	1,162	18	0.013	MH-1203	MH-1163
SP-30121	127.076	125.216	570	8	0.013	MH-2192	MH-30124
SP-30123	125.216	123.729	455	8	0.013	MH-30124	MH-30122
SP-30125	123.729	122.885	258	8	0.013	MH-30122	MH-30120

Pipe ID	Upstream Invert (ft)	Downstream Invert (ft)	Length (ft)	Diameter (in)	Roughness Coefficient	Upstream Manhole	Downstream Manhole
SP-30127	122.885	120.554	714	8	0.013	MH-30120	MH-30118
SP-30129	120.554	118.786	541	8	0.013	MH-30118	MH-30116
SP-30131	118.619	118.066	221	10	0.013	MH-30116	MH-30018
SP-30133	132.733	127.440	667	8	0.013	MH-30126	MH-2346
SP-30135	139.400	132.733	566	8	0.013	MH-2094	MH-30126
SP-30137	122.170	120.270	573	8	0.013	MH-30128	MH-30130
SP-30139	120.270	118.750	457	8	0.013	MH-30130	MH-30132
SP-30141	118.750	117.890	258	8	0.013	MH-30132	WW-30006
SP-30143	117.000	122.928	27	8	120.000	MH-30134	MH-30120
SP-30145	109.800	106.000	104	18	0.013	MH-30136	WW-30008
SP-30151	107.620	110.620	41	14	110.000	MH-30138	MH-30152
SP-30159	110.620	122.590	83	14	110.000	MH-30152	MH-30154
SP-30161	122.590	122.791	502	14	110.000	MH-30154	MH-30150
SP-30163	122.791	122.917	316	14	110.000	MH-30150	MH-30156
SP-30165	122.917	123.037	299	14	110.000	MH-30156	MH-30158
SP-30167	123.037	123.164	319	14	110.000	MH-30158	MH-30160
SP-30169	123.164	123.206	104	14	110.000	MH-30160	MH-30162
SP-30171	123.206	124.890	617	14	110.000	MH-30162	MH-30164
SP-30173	124.890	126.000	559	14	110.000	MH-30164	MH-30166
SP-30175	126.000	124.270	1,073	14	110.000	MH-30166	MH-30170
SP-30177	124.270	122.030	351	14	110.000	MH-30170	MH-30168
SP-30179	122.030	121.430	1,469	14	110.000	MH-30168	MH-30172
SP-30181	121.430	118.070	334	14	110.000	MH-30172	MH-30174
SP-30183	118.070	122.770	144	14	110.000	MH-30174	MH-30176
SP-30185	122.770	124.190	1,169	14	110.000	MH-30176	MH-30178
SP-30187	124.190	124.790	1,500	14	110.000	MH-30178	MH-30180
SP-30189	124.790	134.630	610	14	110.000	MH-30180	MH-30182
SP-30195	134.630	135.560	772	14	110.000	MH-30182	MH-30186
SP-30197	135.560	133.260	321	14	110.000	MH-30186	MH-30188
SP-30199	133.260	135.060	501	14	110.000	MH-30188	MH-30250
SP-30201	136.010	142.200	150	14	110.000	MH-30190	MH-30192
SP-30203	142.200	145.180	332	14	110.000	MH-30192	MH-30194
SP-30205	145.180	148.500	367	14	110.000	MH-30194	MH-30196
SP-30207	148.500	148.750	650	14	110.000	MH-30196	MH-30198
SP-30209	186.000	181.000	26	18	0.013	MH-30224	MH-30218
SP-30211	186.000	181.000	24	18	0.013	MH-30222	MH-30220
SP-30213	148.750	150.000	36	14	110.000	MH-30198	MH-30200
SP-30215	150.000	170.000	63	14	110.000	MH-30200	MH-30202
SP-30217	170.000	170.500	554	14	110.000	MH-30202	MH-30204
SP-30219	170.500	171.300	342	14	110.000	MH-30204	MH-30206
SP-30221	171.300	177.000	337	14	110.000	MH-30206	MH-30208
SP-30223	177.000	186.000	766	14	110.000	MH-30208	MH-30210
SP-30225	186.000	186.000	143	14	110.000	MH-30210	MH-30212
SP-30227	186.000	186.000	7	14	110.000	MH-30212	MH-30226
SP-30233	186.000	186.000	16	48	0.013	MH-30226	MH-30222
SP-30235	186.000	186.000	39	48	0.013	MH-30226	MH-30224
SP-30239	137.940	136.490	591	10	0.013	MH-30030	MH-30288
SP-30241	135.060	136.010	258	14	110.000	MH-30250	MH-30190
SP-30243	125.890	125.885	1	8	0.013	MH-30252	MH-30286
SP-30295	114.990	114.720	141	12	0.013	MH-30102	MH-30284
SP-30299	136.490	134.720	715	10	0.013	MH-30288	MH-30290
SP-30301	134.720	133.520	621	12	0.013	MH-30290	MH-30292
SP-30303	133.520	132.050	765	12	0.013	MH-30292	MH-30294
SP-30305	132.050	131.080	672	15	0.013	MH-30294	MH-30286

APPENDIX C

H2OMAP WATER FILES
(COMPUTER MODEL OF FORCE MAINS)
AND MISCELLANEOUS FORCE MAIN MODELING INFO

Pipe ID	Description	Length (ft)	Diameter (in)	Roughness Coefficient	From Node	To Node
11	New Pipe	65	14	100	143	137
13	New Pipe	286	14	100	55	57
15	New Pipe	315	14	100	57	59
17	New Pipe	295	14	100	59	61
19	New Pipe	383	14	100	61	63
21	New Pipe	139	14	100	63	65
23	New Pipe	602	14	100	65	67
25	New Pipe	541	14	100	67	69
27	New Pipe	1,041	14	100	69	71
29	New Pipe	371	14	100	71	73
31	New Pipe	523	14	100	73	77
33	New Pipe	1,075	14	100	77	79
35	New Pipe	371	14	100	79	81
37	New Pipe	131	14	100	81	83
39	New Pipe	1,024	14	100	83	85
41	New Pipe	1,362	14	100	85	145
43	New Pipe	274	14	100	87	163
45	New Pipe	394	14	100	89	197
47	New Pipe	62	14	100	129	139
49	New Pipe	280	14	100	13	15
51	New Pipe	317	14	100	15	17
53	New Pipe	299	14	100	17	19
55	New Pipe	396	14	100	19	21
57	New Pipe	131	14	100	21	23
59	New Pipe	593	14	100	23	25
61	New Pipe	552	14	100	25	27
63	New Pipe	1,020	14	100	27	29
65	New Pipe	376	14	100	29	31
67	New Pipe	497	14	100	31	75
69	New Pipe	26	18	100	75	33
71	New Pipe	45	12	100	201	47
73	New Pipe	50	12	100	201	51
75	New Pipe	1,532	12	100	47	49
77	New Pipe	1,025	12	100	49	33
79	New Pipe	1,537	12	100	51	53
81	New Pipe	1,022	12	100	53	75
83	New Pipe	1,067	18	100	33	35
85	New Pipe	374	18	100	35	37
87	New Pipe	132	18	100	37	39
89	New Pipe	1,047	18	100	39	41
91	New Pipe	1,388	18	100	41	153
93	New Pipe	271	18	100	43	161
95	New Pipe	388	18	100	45	195
97	New Pipe	58	8	100	207	95
99	New Pipe	529	8	100	95	97
101	New Pipe	786	8	100	97	99
103	New Pipe	619	8	100	99	101
105	New Pipe	667	8	100	101	103
107	New Pipe	618	8	100	103	105
109	New Pipe	1,049	8	100	105	107
111	New Pipe	2,604	8	100	107	109
113	New Pipe	63	8	100	209	113
115	New Pipe	529	8	100	113	115
117	New Pipe	750	8	100	115	117

Pipe ID	Description	Length (ft)	Diameter (in)	Roughness Coefficient	From Node	To Node
119	New Pipe	643	8	100	117	119
121	New Pipe	652	8	100	119	121
123	New Pipe	578	8	100	121	123
125	New Pipe	1,078	8	100	123	125
127	New Pipe	2,653	8	100	125	127
129	New Pipe	21	8	100	109	127
131	New Pipe	71	12	100	127	187
133	New Pipe	399	12	100	111	199
137	New Pipe	189	14	100	137	55
139	New Pipe	189	14	100	139	13
141	New Pipe	58	14	100	203	129
143	New Pipe	53	14	100	141	143
145	New Pipe	624	14	100	145	155
147	New Pipe	943	18	100	147	157
149	New Pipe	510	14	100	149	87
151	New Pipe	295	14	100	151	149
153	New Pipe	622	18	100	153	147
155	New Pipe	943	14	100	155	151
157	New Pipe	297	18	100	157	159
159	New Pipe	509	18	100	159	43
161	New Pipe	118	18	100	161	165
163	New Pipe	116	14	100	163	167
165	New Pipe	294	18	100	165	169
167	New Pipe	291	14	100	167	171
169	New Pipe	382	18	100	169	173
171	New Pipe	385	14	100	171	177
173	New Pipe	529	18	100	173	179
177	New Pipe	530	14	100	177	181
179	New Pipe	70	18	100	179	183
181	New Pipe	71	14	100	181	185
183	New Pipe	704	18	100	183	189
185	New Pipe	703	14	100	185	191
187	New Pipe	702	12	100	187	193
189	New Pipe	296	18	100	189	45
191	New Pipe	312	14	100	191	89
193	New Pipe	331	12	100	193	111
195	New Pipe	762	18	100	195	11
197	New Pipe	801	14	100	197	91
199	New Pipe	829	12	100	199	93
207	New Pipe	10	14	100	211	213
209	New Pipe	17	14	100	213	141
211	New Pipe	5	14	100	213	215
213	New Pipe	22	14	100	215	203
219	New Pipe	32	8	100	219	209
221	New Pipe	22	8	100	219	207
223	New Pipe	21	12	100	93	7006
225	New Pipe	14	14	100	91	7006
227	New Pipe	25	18	100	11	7006
229	New Pipe	37	8	100	127	179

APPENDIX D

EAST STREET PUMP STATION PUMP CURVES

88 hp

FLYGT	PERFORMANCE CURVE	PRODUCT: CP3300.181	TYPE: HT
DATE: 2002-02-04	PROJECT	CURVE NO: 63-454-00-2050	ISSUE: 2

	1/1-LOAD	3/4-LOAD	1/2-LOAD
MOTOR COS PHI	0.85	0.82	0.75
MOTOR EFFICIENCY	89.5 %	89.5 %	88.0 %
GEAR EFFICIENCY	---	---	---

MOTOR SHAFT POWER	88	hp
STARTING CURRENT ...	540	A
RATED CURRENT ...	108	A
RATED SPEED	1770	rpm
TOT.MOM.OF INERTIA ...	1.4	kgm2
NO. OF BLADES	1	

COMMENTS

INLET/OUTLET: - /150 mm

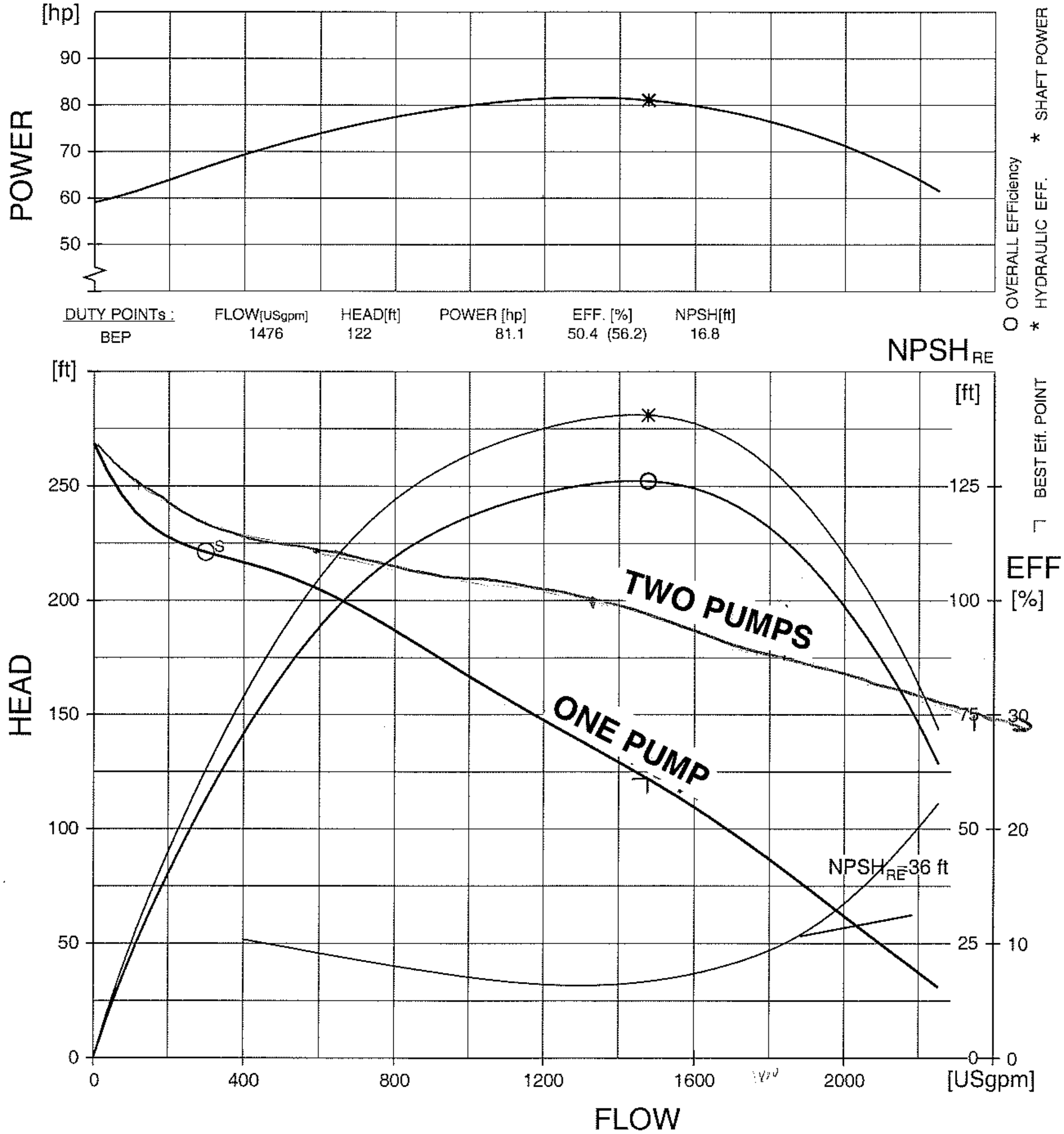
IMP. THROUGHLET: 76 mm

IMPELLER DIAMETER: 401 mm

MOTORTYPE	STATOR	REV
35-28-4AA	38D	10

FREQ.	PHASES	VOLTAGE	POLES
60 Hz	3	460 V	4

GEARTYPE	RATIO
---	---



DUTY POINTs :	FLOW[USgpm]	HEAD[ft]	POWER [hp]	EFF. [%]	NPSH[ft]
BEP	1476	122	81.1	50.4 (56.2)	16.8

S: RISK OF SEDIMENTATION AT VELOCITY BELOW 0.6 m/s
(Point (S) show risk in a 200 mm pipe)

CURVES SHOW PERFORMANCE WITH CLEAR COLD WATER

FLYGT CURVE

47hp

FLYGT	PERFORMANCE CURVE	PRODUCT: CP3201.180	TYPE: HT
DATE: 2002-02-04	PROJECT:	CURVE NO: 63-452-00-5350	ISSUE: 3

	1/1-LOAD	3/4-LOAD	1/2-LOAD
MOTOR COS PHI	0.89	0.86	0.80
MOTOR EFFICIENCY	87.5 %	87.5 %	86.0 %
GEAR EFFICIENCY	---	---	---

MOTOR SHAFT POWER	47	hp
STARTING CURRENT ...	375	A
RATED CURRENT ...	57	A
RATED SPEED	1755	rpm
TOT.MOM.OF INERTIA ...	0.58	kgm2
NO. OF BLADES	1	

COMMENTS

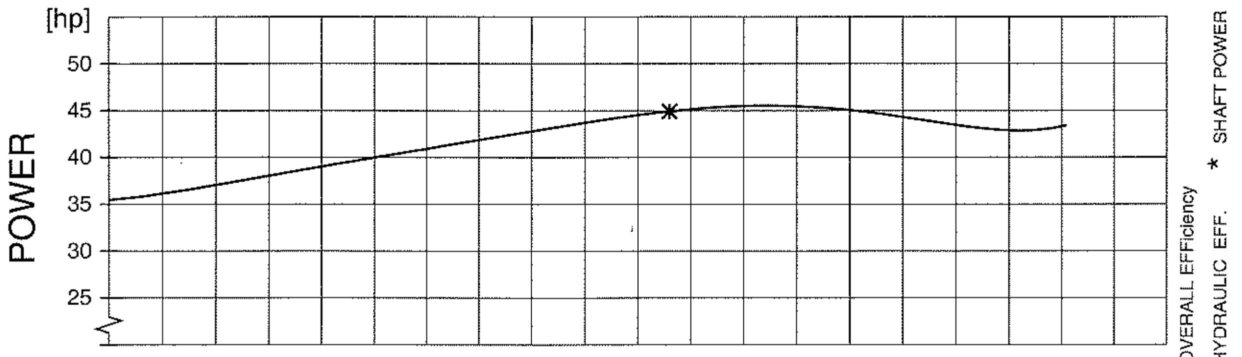
INLET/OUTLET	IMP. THROUGHLET
- /150 mm	77 mm

IMPELLER DIAMETER: 330 mm

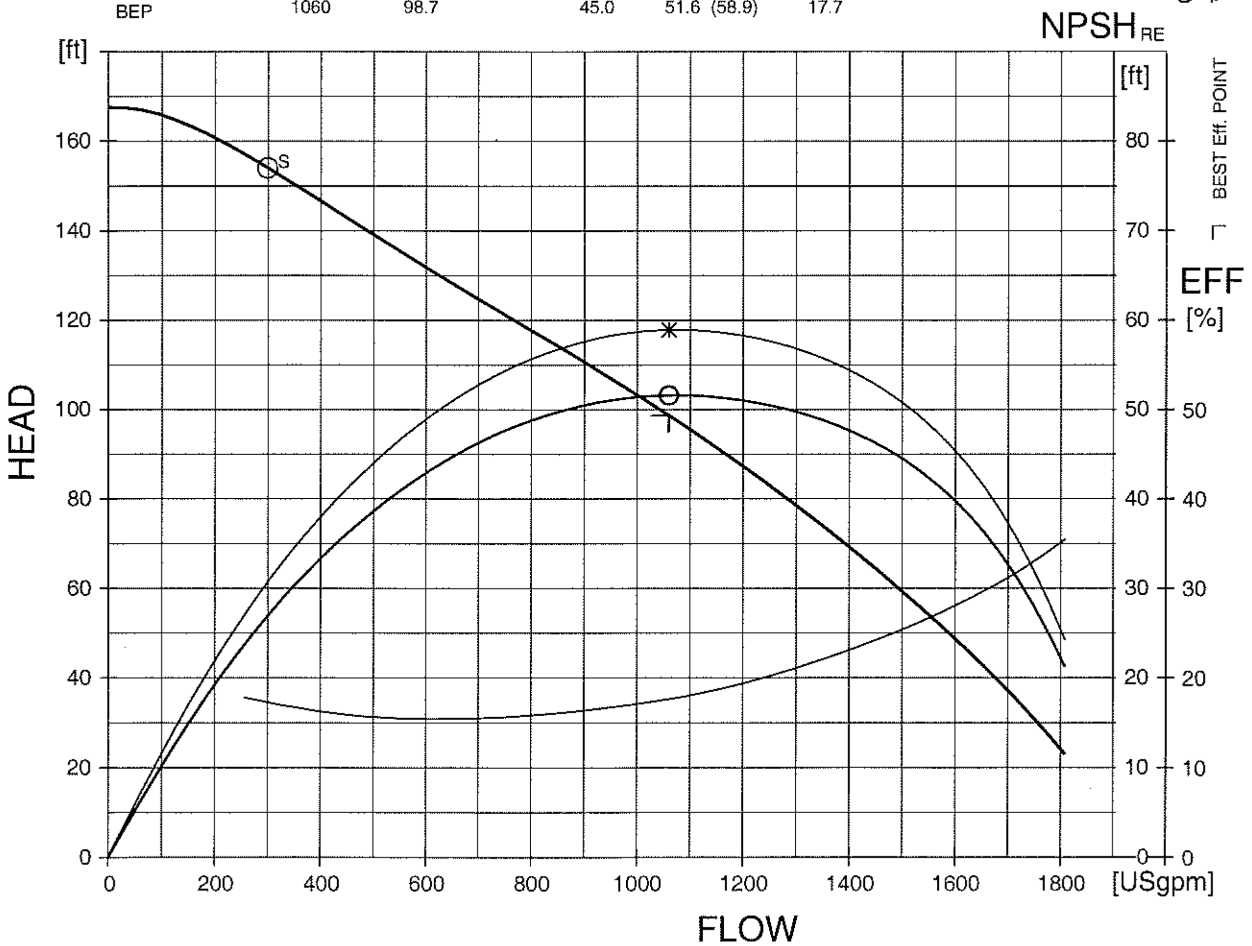
MOTORTYPE	STATOR	REV
27-26-4AA	37YSER	10

FREQ.	PHASES	VOLTAGE	POLES
60 Hz	3	460 V	4

GEARTYPE	RATIO
---	---



DUTY POINTs :	FLOW[USgpm]	HEAD[ft]	POWER [hp]	EFF. [%]	NPSH[ft]
BEP	1060	98.7	45.0	51.6 (58.9)	17.7



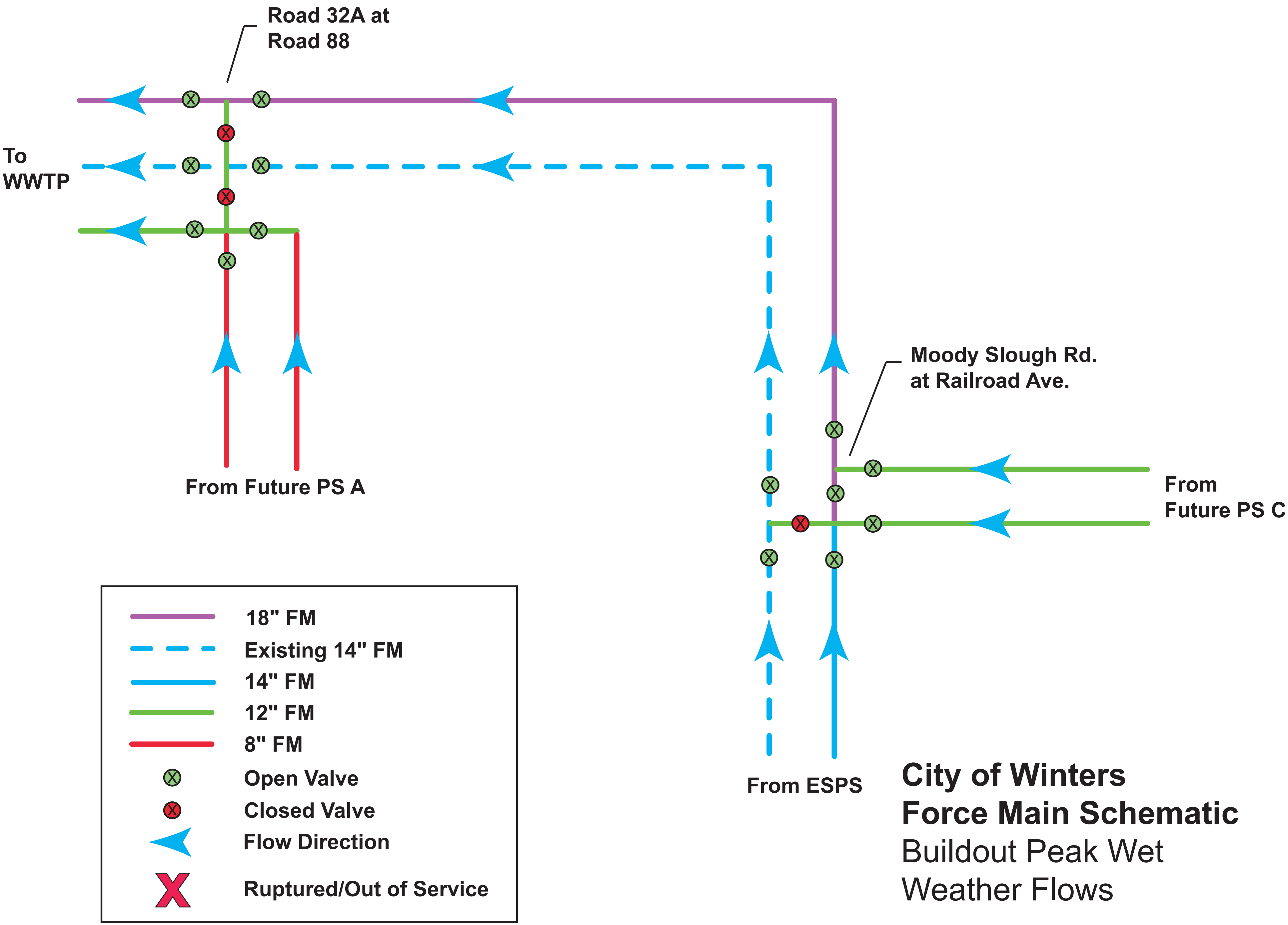
S: RISK OF SEDIMENTATION AT VELOCITY BELOW 0.6 m/s
(Point (S) show risk in a 200 mm pipe)

CURVES SHOW PERFORMANCE WITH CLEAR COLD WATER

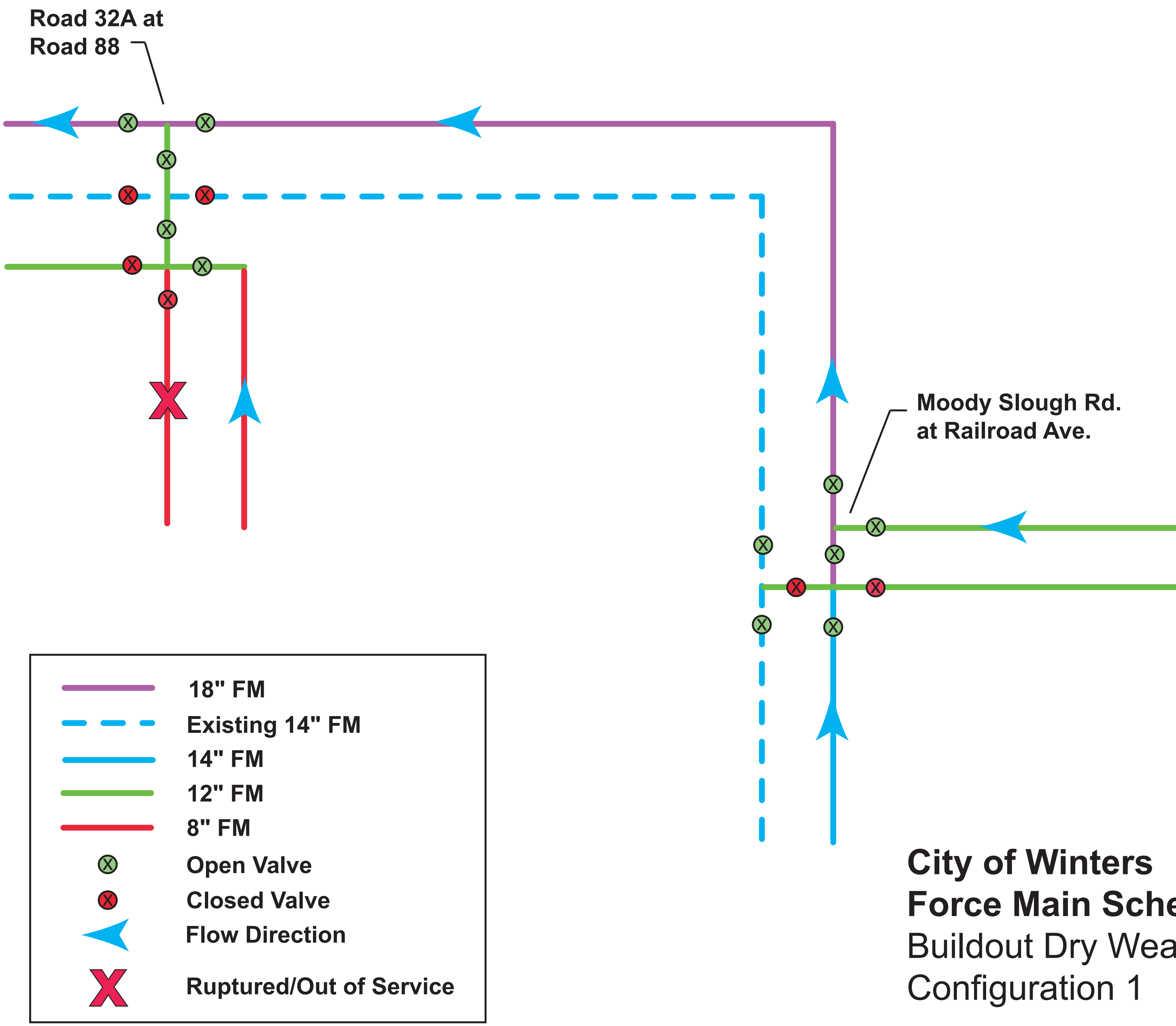
FLYGT CURVE

APPENDIX E

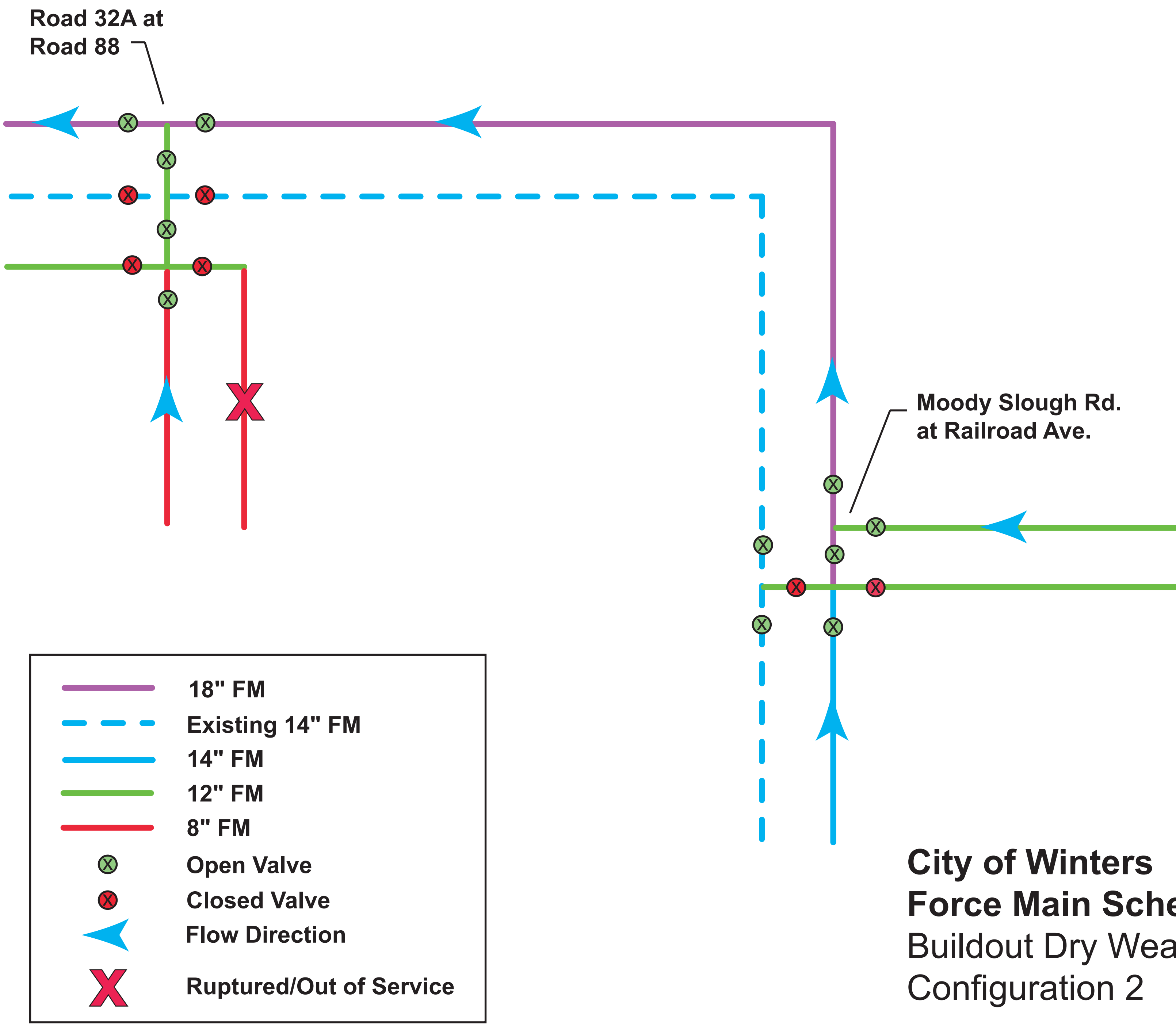
FORCE MAIN VALVING CONFIGURATIONS



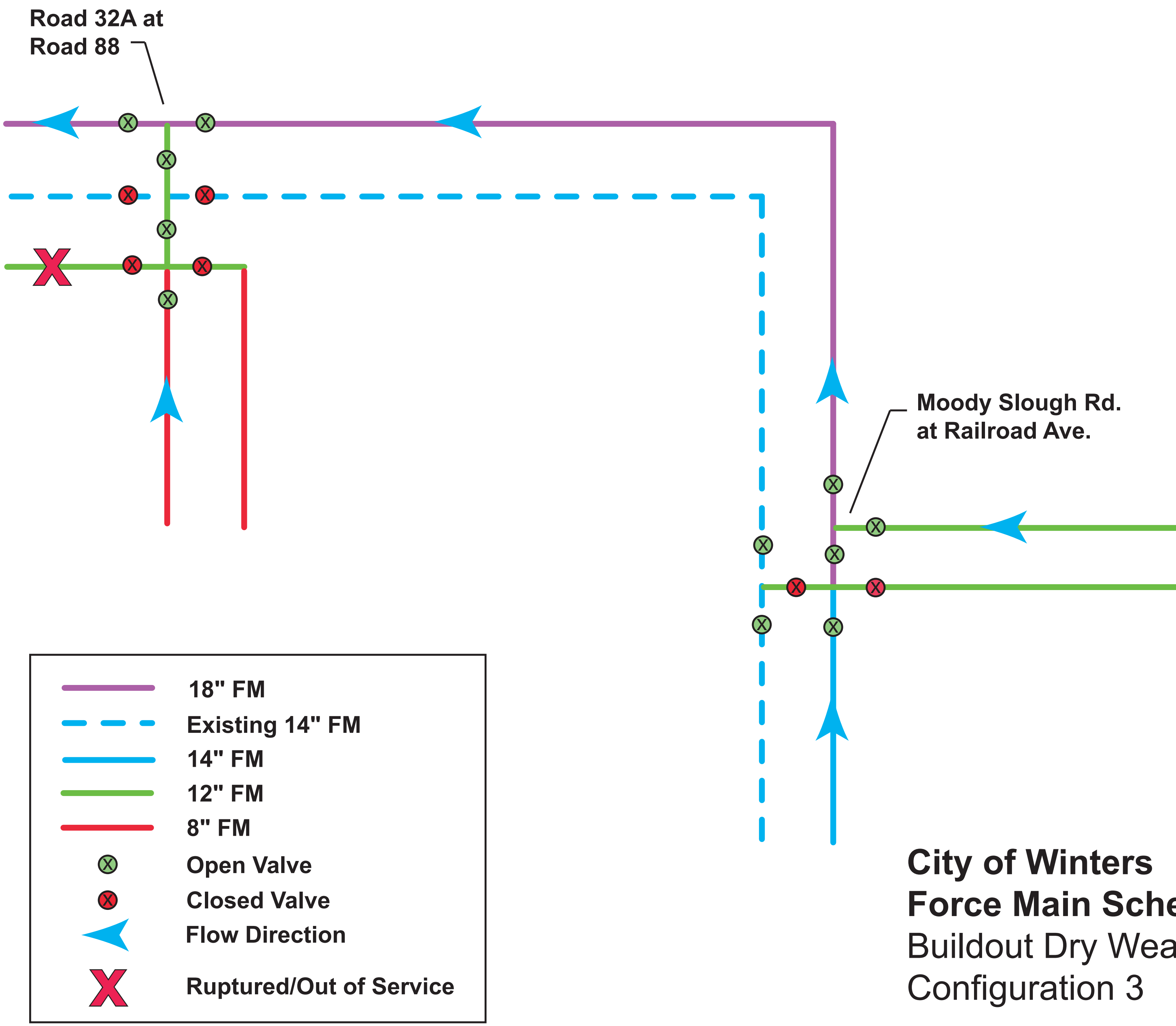
City of Winters
Force Main Schematic
Buildout Peak Wet
Weather Flows



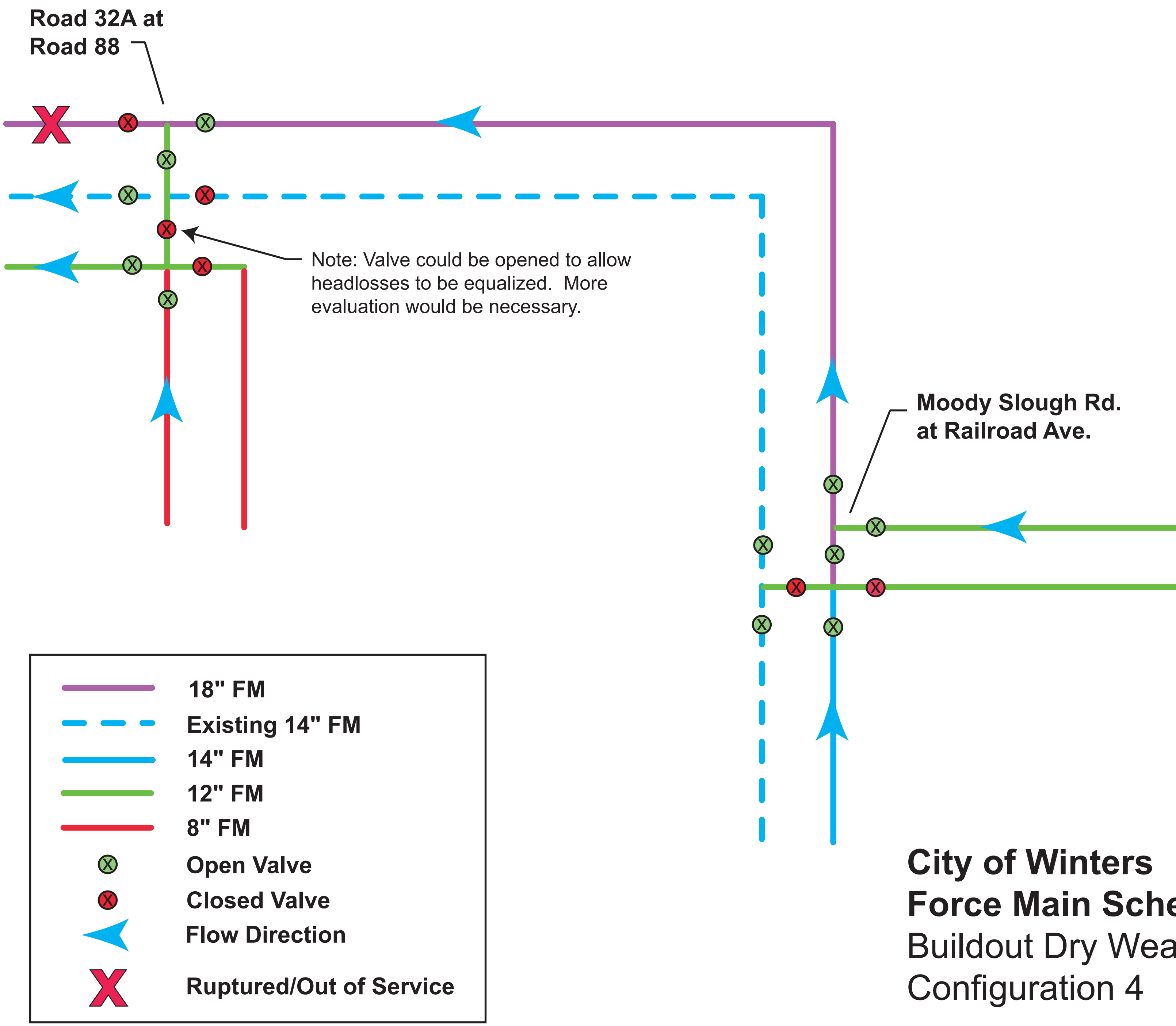
City of Winters
Force Main Schematic
Buildout Dry Weather Flows
Configuration 1



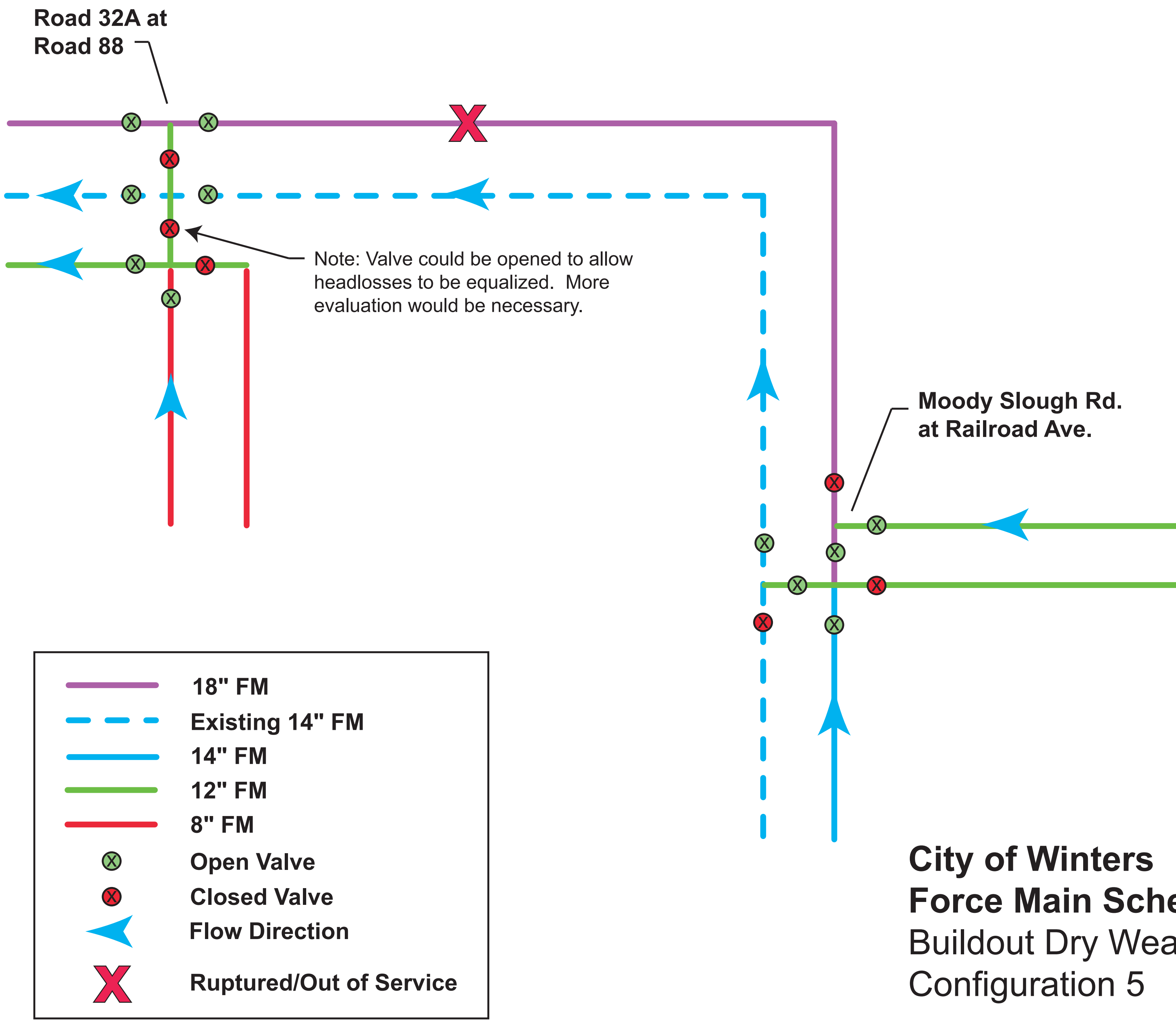
City of Winters
Force Main Schematic
Buildout Dry Weather Flows
Configuration 2



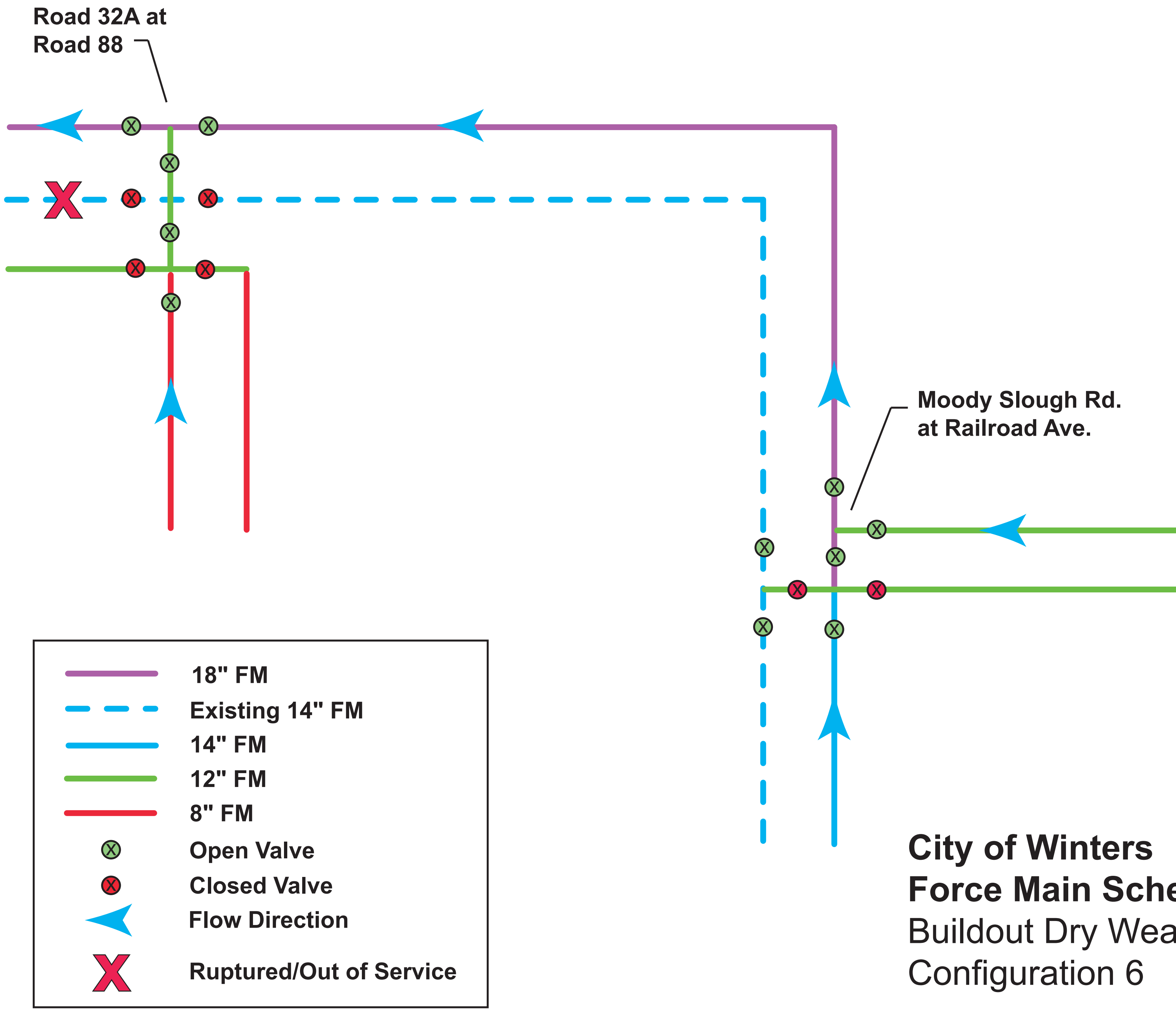
City of Winters
Force Main Schematic
Buildout Dry Weather Flows
Configuration 3



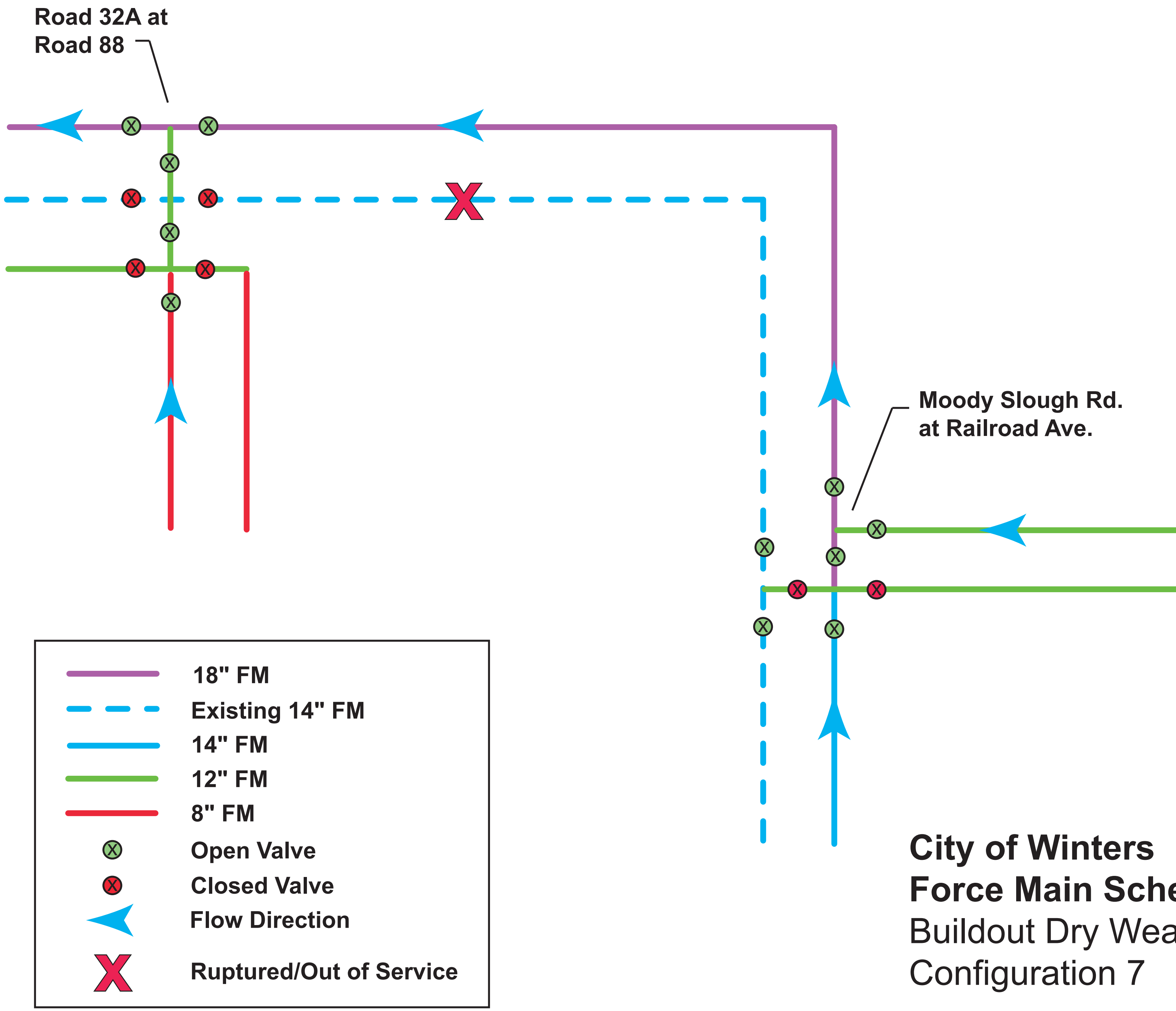
City of Winters
Force Main Schematic
Buildout Dry Weather Flows
Configuration 4



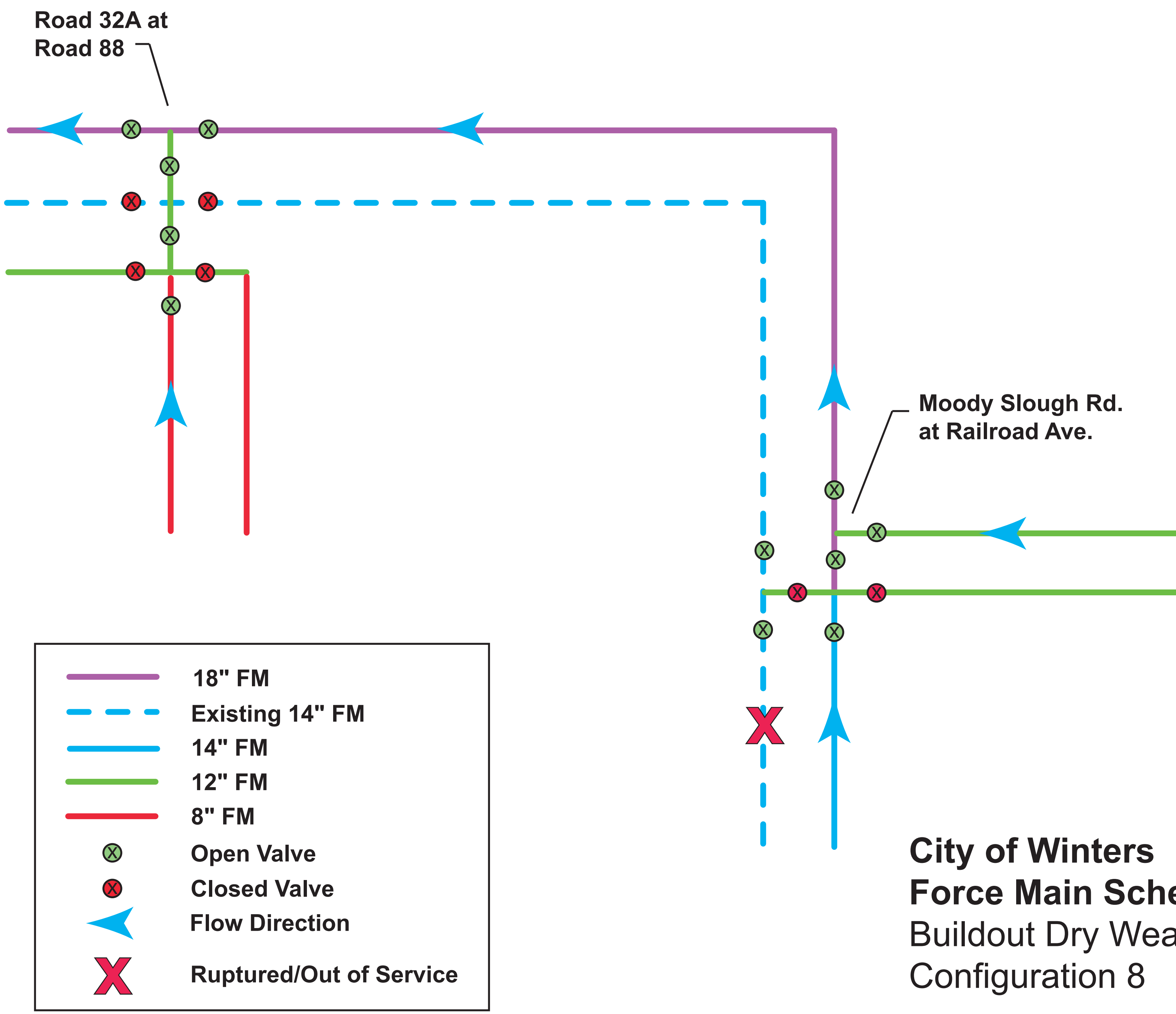
City of Winters
Force Main Schematic
Buildout Dry Weather Flows
Configuration 5



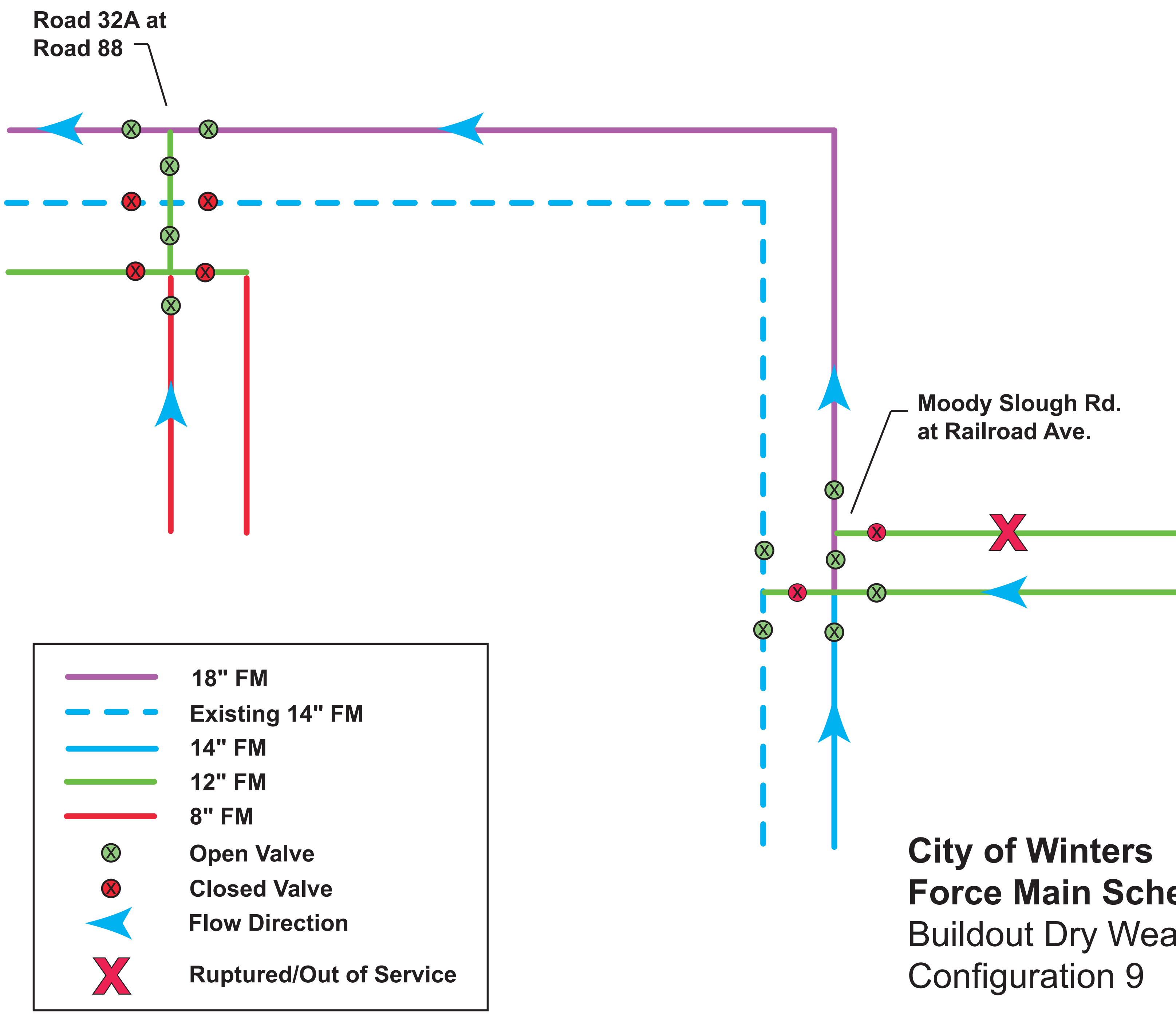
City of Winters
Force Main Schematic
Buildout Dry Weather Flows
Configuration 6



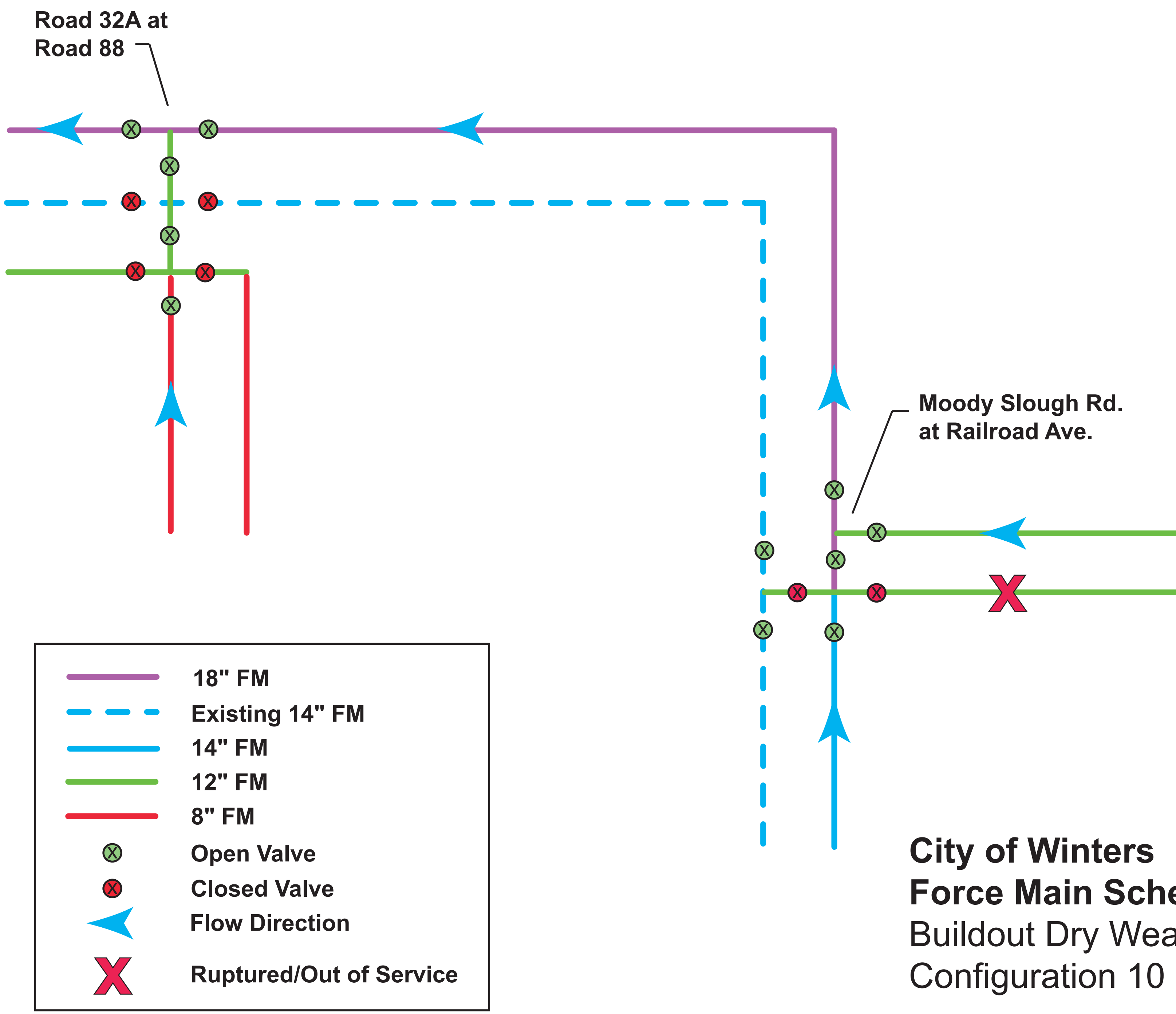
City of Winters
Force Main Schematic
Buildout Dry Weather Flows
Configuration 7



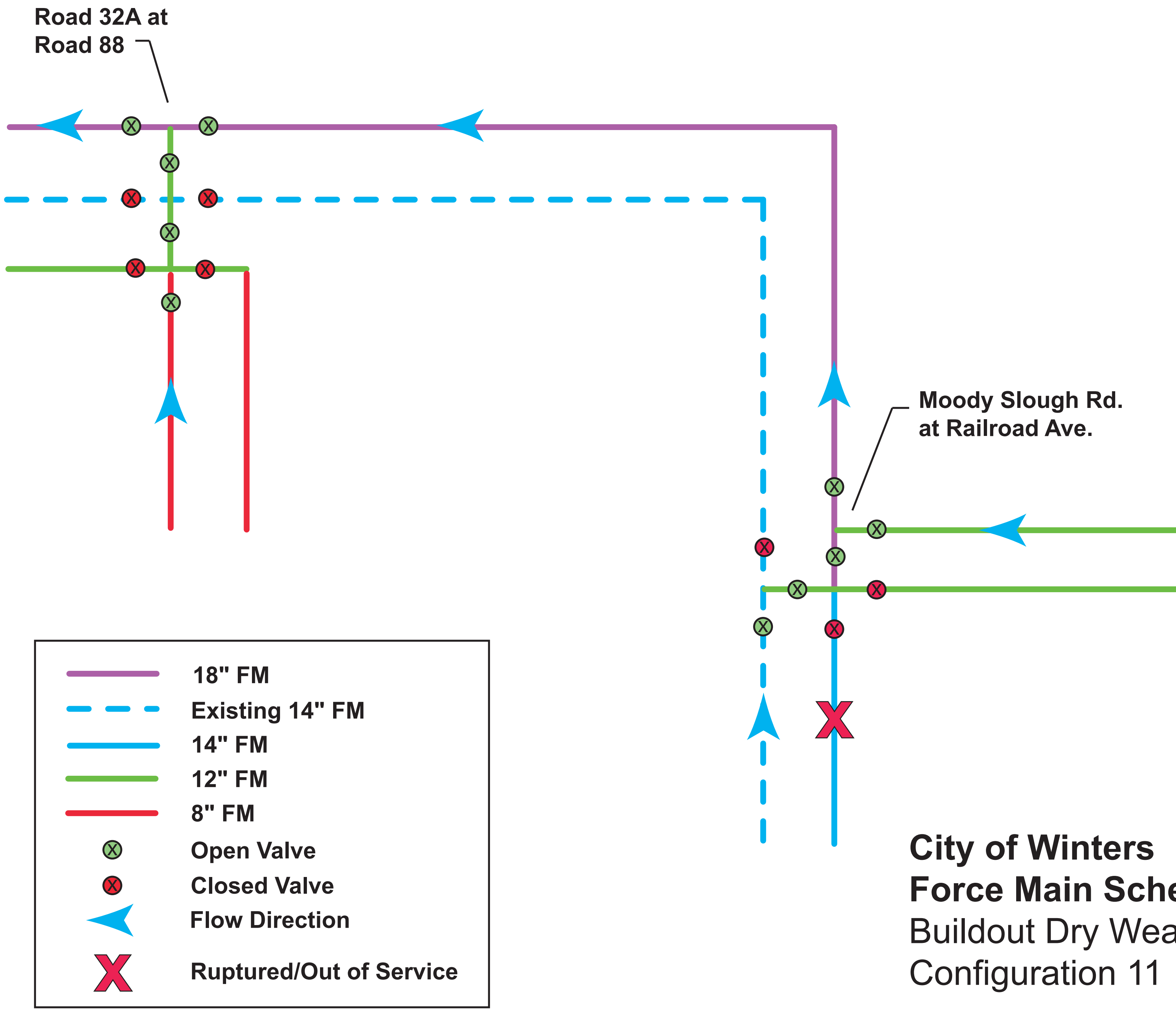
City of Winters
Force Main Schematic
Buildout Dry Weather Flows
Configuration 8



City of Winters
Force Main Schematic
Buildout Dry Weather Flows
Configuration 9



City of Winters
Force Main Schematic
Buildout Dry Weather Flows
Configuration 10



City of Winters
Force Main Schematic
Buildout Dry Weather Flows
Configuration 11

APPENDIX F

TECHNICAL MEMORANDA

Technical Memorandum 1B

City of Winters – Sewer System Master Plan

Subject:	Sewer Collection Design Criteria for Master Planning - FINAL
Prepared For:	Michael Karoly, PE - City of Winters
Prepared By:	Glenn E. Hermanson, P.E.
Reviewed By:	Jeff Lewandowski, P.E., D. Eng.
Date:	August 17, 2004 (FINAL) October 20, 2003 (DRAFT)
Reference:	098.0021

Introduction

This Technical Memorandum (TM) presents the design criteria recommended for use for the Sewer Master Plan for the City of Winters. These criteria will serve as the basis for evaluating the hydraulic adequacy of existing facilities and for establishing the alignment and size of future facilities, including gravity trunk sewers, pump stations, and force mains. Design assumptions that are not required for master planning, but are necessary for cost estimation purposes (e.g., pipe material, thickness of pavement restoration, manhole spacing) will be presented in the TM on Recommended System Improvements. A separate TM will include recommended Design Flow Criteria, including unit flow factors and procedures for calculating peak dry and wet weather design flows.

This TM includes a brief discussion of each of the following items and recommendations for design criteria for the Winters Master Plan.

A. Manning's *'n'* factor
B. Minimum Pipe Size
C. Maximum Allowable Flow Depth
D. Minimum Velocity/Slope
E. Maximum Velocity
F. Maximum Collector Sewer Depth
G. Minimum Pipe Depth
H. Design Requirements at Increases in Pipe Size
I. Headloss in Manholes
J. Hydraulic Design Criteria for Force Mains
K. Inverted Siphons

Summary of Recommended Master Plan Design Criteria

A summary of the recommended design criteria is presented in Table 1.

Table 1: Recommended Master Plan Design Criteria

Criteria	Recommended Value
Manning's *'n'*	0.013 for all materials
Minimum Gravity Sewer Pipe Size	8 inches
Maximum Allowable Flow Depth (d/D)	Under peak design flow conditions: ▪ d/D = 0.7 for 8- and 10-inch pipe and 12-inch pipe with service connections ▪ d/D = 1.0 for 12-inch (without service connections) and larger pipe.
Minimum Velocity/Slope	▪ Criteria 1: Minimum design slope selected to provide a minimum velocity of 2 fps for sewers between 8- and 18-inch and a minimum velocity of 3 fps for sewers 39-inch and larger. For sewers between 21- and 36-inch, the minimum slope allows the velocity to transition from 2 fps to 3 fps. Velocities calculated with Manning's '*n*' =0.013 and full pipe conditions. See Table 5. ▪ Criteria 2: Minimum velocity of 2 fps at peak dry weather flow at buildout.
Maximum Velocity	10 fps
Maximum Collector Sewer Depth	8- and 10-inch pipe and 12-inch pipe with service connections have a maximum depth of 16 feet.
Minimum Pipe Depth	▪ Provide a minimum depth to pipe invert of 7 feet for all gravity sewers including the sewers at the periphery of the system. ▪ At least 4 feet of separation between the flow line of creeks and the crown of the sewer at creek crossings.
Increases in Pipe Size	▪ Match crowns when increasing in pipe size. ▪ Set branch sewer elevations 0.1 ft. above the main sewer elevation when the branch sewer is the same size as the main sewer.
Headloss in Manholes	Deflection manholes with deflections greater than 20 degrees are assigned a 0.1-foot drop. Deflections greater than 90 degrees are not allowed.
Force Mains	▪ Maximum velocity: 8 fps during PWWF at buildout. ▪ Minimum velocity: 3.5 fps with one pump running (force mains with 20% slope or less); additional analysis required (force mains with greater than 20% slope) ▪ A method to allow dewatering and internal inspection of force mains during summertime flow shall be provided. For short force mains that do not cross railroads, freeways, or rivers, bypass pumping using temporary above ground piping is acceptable. For long force mains, dual force mains are one solution, but other solutions are possible depending on the site. Future inspection requirements: o Future inspection will be considered. With no better solution, a second force main will be identified in the master plan after 20 years. o Dual force mains would not be required at the initial stage unless low initial flows (and velocities) require dual pipelines to keep grit moving. ▪ Pipe friction will be calculated using the Hazen-Williams formula with a roughness coefficient C = 100 for all pipe sizes and materials.

Criteria	Recommended Value
Inverted Siphons	▪ Avoid inverted siphons whenever possible. ▪ Downflow and upflow legs of the siphon have a maximum slope of 15%. ▪ Upstream invert elevation will be calculated by adding 12 inches plus the pipe friction to the downstream invert elevation. ▪ Pipe friction will be calculated using the Hazen-Williams formula with a roughness coefficient C = 100. ▪ Minimum velocity of 3 fps at ADWF during early years of operation ▪ Minimum velocity of 4 fps at PDWF during early years of operation. ▪ Minimum pipe diameter of 8 inches and minimum of two barrels. ▪ The downstream manhole must be located in an easily accessed location and safely accessed (busy street locations are not allowed).

A. Manning’s ‘n’ Factor

Manning's 'n' roughness coefficient is the friction factor utilized in the Manning's Equation for gravity flow to describe the roughness of a particular pipe material or condition. There has been much debate over the idea that the ‘n’ value of a pipe can change over time as the pipe ages and a slime layer grows on the pipe wall. One side of the debate claims that the roughness or ‘n’ value of this slime layer is the same whether the slime layer grows on a concrete wall, a vitrified clay wall, or a plastic wall. The other side of this debate proposes that a different ‘n’ value should be used for different pipe materials, generally ranging from 0.008 for plastic pipe to 0.016 for unlined concrete pipe (Jeppson, 1976) with vitrified clay pipe between the two values.

Hydraulic laboratory measurements of Manning's ‘*n*’ roughness coefficients on new pipe vary little between plastic and concrete pipe. May *et al* (1986) report values of 0.009 for plastic pipe to 0.010 for unlined concrete pipe. Bloodgood and Bell (1961) found an average Manning's ‘*n*’ for asbestos cement pipe of 0.0109. Straub *et al* (1960) reported values of 0.0106 for tamped concrete pipe and 0.009 for cast concrete pipe.

Table 2 shows the Manning's *‘n’* value used by various agencies. The majority of these agencies specify a Manning's *‘n’* of 0.013. Some sewerage agencies believe that after a period of time, the deterioration of the pipe surface and joints increase friction, and recommend that a higher *‘n’* value should be used in design. The City of Los Angeles requires an *‘n’* value of 0.014 in their design standards for sanitary sewers.

Table 2: Comparison of Manning’s *‘n’*, Minimum Pipe Size, and Maximum Velocity Criteria of Various Agencies

Agency	Manning’s *‘n’*	Minimum Pipe Size (in.)	Maximum Velocity (fps)[(1)]
Central Contra Costa Sanitary District	0.013	8	not specified
City of Los Angeles	0.014	8	not specified
Washington Suburban Sanitary Commission	0.013	8	15
City of Dallas	0.013	6	10
City of Phoenix	0.013	8	9
Clark County Sanitation District (NV)	0.013	8	10
City of Bellevue (WA)	not specified	8	10
Sacramento County (CSD-1)	0.013	8	not specified
City of Winters	**0.013**	**8**	**not specified**

[(1)] Most agencies allow the maximum velocity to be exceeded if special design procedures are followed.

A Manning's '*n*' design value of 0.013, the most widely accepted value in the industry, provides some degree of conservatism if, in fact, there is a significant benefit to the smoother plastic pipe and PVC-lined (T-lock) pipe walls. For the Winters Sewer Master Plan, it is recommended that an '*n*' value of 0.013 be used for all pipe materials.

B. Minimum Pipe Diameter

Although there are some agencies that allow new 6-inch sewers (and many agencies, including Winters, that have substantial amounts of existing 6-inch pipe), a minimum sanitary sewer pipe size of 8-inches is generally accepted as the industry standard and is the current proposed Winters design criteria. Therefore, except for service lines (laterals), the minimum acceptable gravity pipe diameter for all newly constructed pipelines in this Master Plan shall be 8 inches.

C. Maximum Allowable Flow Depth

Depending on the pipe size, three different criteria concerning the depth of flow are being used by major sewer agencies in California.

1) For smaller pipes, usually up to 12 or 15 inch in diameter, the depth of flow to pipe diameter (d/D) ratio of 0.7 or 0.75 is used for the design at peak flow. This lower (d/D) ratio is more conservative and is used to prevent flow blockages in smaller pipes due to debris and avoid potential backup into connected service laterals.

2) Larger pipes (18 inches and larger) are generally designed to flow full at design flow conditions. A pipe designed for full or 100 percent capacity has a d/D ratio of 1.0. Higher pipe capacities at d/D ratios of 0.8 to 1.0 will not be considered.

3) In order to save costs, some agencies allow surcharging of large diameter gravity flow sewers under peak flows associated with infrequent (long return period) storm events. The main disadvantage of this approach is that once surcharging is allowed, its extent is hard to control and may result in flooding of basements and other low lying areas, and low flow velocities that may cause solids to settle out in the pipe. Also, gravity sewers are not designed for pressure flows, and flows under surcharged conditions may result in some exfiltration of sewage.

For the Winters' Sewer Master Plan, it is recommended that the maximum depth of flow at peak design conditions in any collector (10-inch diameter or less) shall be 0.7 of the pipe diameter. Sewers 12 inches in diameter and larger may be designed to flow full unless direct service connections are planned, in which case the 0.7 diameter maximum depth shall govern. This criteria is widely accepted and complies with proposed City improvement standards.

D. Minimum Velocity/Slope

For municipal wastewater with its associated grit and solids content, 2 fps is commonly used as the minimum design velocity at full or half full pipe flow conditions. When the sewers are less than half full, the velocities are below 2 fps. When the depth of sewage is greater than half full, the velocity increases above 2 fps until a maximum velocity is reached at approximately 94 percent of full pipe depth. From 94 percent depth to full pipe, the velocity decreases back to 2 fps.

Comparison of Standards Used by Other Agencies

Table 3 lists the full pipe velocity criteria used by various cities and agencies. The criteria were found in the respective standards or design manuals.

Table 3: Comparison of Minimum Velocity Criteria of Various Agencies

Agency	Minimum Velocity (fps)	Condition
Central Contra Costa Sanitary District	2 [(1)]	At half pipe and full pipe conditions.
City of Los Angeles	3 [(2)]	At peak dry weather flow that exists at the time the pipe is placed into service.
Washington Suburban Sanitary Commission	2.5 [(3)]	At half pipe and full pipe conditions.
City of Dallas	2	At half pipe and full pipe conditions.
City of Phoenix	2	At half pipe and full pipe conditions.
Clark County Sanitation District (NV)	2 [(3)]	At half pipe and full pipe conditions.
Sacramento County	2 to 3[(4)]	At half pipe and full pipe conditions.

(1) Minimum velocity in small sewers (8", 10" and 12") is required to be higher.
(2) Minimum velocity in upstream terminal reach is allowed to be lower.
(3) Minimum velocity in upstream terminal reach is required to be higher.
(4) Minimum velocity is 2 fps for 8 to 18-inch, 3 fps for 39-inch plus, and varies from 2 fps to 3 fps between 21- and 36-inch.

Once a minimum velocity and Manning's '*n*' are selected, the pipe slope can be calculated. Table 4 presents the minimum pipe slopes for various agencies for pipe sizes ranging from 8 to 36 inches. County Sanitation District 1 of Sacramento County (CSD-1) has over 2500 miles of mainline sewers and based on observed conditions in their various trunk sewers, they recently steepened their minimum required slopes for sewers greater that 18-inch. CSD-1 now requires that sewers 39-inches and greater have a minimum velocity of 3 feet per second (fps) at full pipe flow and that sewers from 21- to 36-inches in diameter transition from 2 fps to 3 fps. While this change in slope is minor, the decrease in maintenance requirements is noticeable.

Based on historical work order data and blockage reports, CSD-1 has determined that the terminal sewer reaches (sewers in cul-de-sacs for example) require more maintenance than downstream sewers. Although they have not yet modified their standards, they are considering steepening their required minimum slope for terminal sewer reaches. As shown in Table 4, various leading sanitation agencies currently require steeper terminal reaches. Until this requirement is more common in Northern California, we are not proposing this requirement for Winters.

Table 4: Minimum Pipe Slopes for Various Agencies [(4)] [(5)]

Pipe Size (in.)	Central Contra Costa Sanitary District	City of Los Angeles	Washington Suburban Sanitary Commission	City of Dallas	City of Phoenix	Clark County Sanitation District	Sacramento County (CSD-1)	Winters' Draft Design Standards
8	0.0077	0.0087 0.0044 [(1)] 0.0060 [(2)]	0.0050 0.0100 [(3)]	0.0033	0.0033	0.0033 0.0060 [(3)]	0.0035	0.0035
10	0.0057	0.0065	0.0040	0.0025	0.0024	0.0025	0.0025	0.0025
12	0.0022	0.0051	0.0030	0.0020	0.0019	0.0020	0.0020	0.0020
15	0.0015	0.0038	0.0019	0.0015	0.0014	0.0015	0.0015	0.0015
18	0.0012	0.0030	0.0015	0.0011	0.0011	0.0012	0.0012	0.0012
21	0.00095	0.00239	0.00120	0.00090	0.00092	0.00092	0.0012	0.00092

Pipe Size (in.)	Central Contra Costa Sanitary District	City of Los Angeles	Washington Suburban Sanitary Commission	City of Dallas	City of Phoenix	Clark County Sanitation District	Sacramento County (CSD-1)	Winters' Draft Design Standards
24	0.00080	0.00200	0.00100	0.00080	0.00077	0.00077	0.0011	0.00077
27	0.00070	0.00171	0.00102	0.00060	0.00066	0.00066	0.0010	0.00066
30	0.00060	0.00149	0.00089	0.00055	0.00057	0.00057	0.0010	0.00057
33	0.00055	0.00131	0.00078	0.00050	0.00050	0.00050	0.0010	0.00050
36 (6)	0.00050	0.00117	0.00070	0.00045	0.00045	0.00045	0.0010	0.00045

(1) Minimum slope in upper reaches of system with few connections.
(2) Minimum slope in upstream terminal reach.
(3) Minimum slope in upstream terminal reach.
(4) Agencies using 2 fps criteria: Sacramento County, Dallas, Phoenix, Clark County Sanitation District.
Agencies using 2.5 fps: Washington Suburban Sanitary Commission
Agencies using 3 fps: Los Angeles.
(5) Agencies using Manning's 'n' coefficient =0.013: Sacramento County, CCCSD, WSSC, Dallas, Phoenix, CCSD.
Agencies using Manning's 'n' coefficient =0.014: Los Angeles.

Recommendations for Minimum Slopes and Velocities

Two criteria are recommended to determine the design minimum slopes for sewers in Winters. The first criteria requires the minimum design slopes (see Table 6) to provide a minimum velocity of 2 fps for sewers between 8 and 18 inches in diameter and a minimum velocity of 3 fps for sewers 39 inches and larger. For sewers between 21 and 36 inches, the minimum slope allows the velocity to transition from 2 fps to 3 fps. The velocities are calculated with Manning's '*n*' =0.013 and full pipe conditions. The second criteria requires the design slope to provide a minimum velocity of 2 fps at peak dry weather flow at buildout. This criteria will minimize the possibility of inexperienced designers trying to meet depth requirements by oversizing the sewers and flattening the slope.

Recommended Minimum Slopes for Trunk Shed Plans.

This Master Plan will recommend sewer trunks and describe the collection system configuration of areas in the City that will be developed in the future. These configurations may consist of sewer alignments that are fairly fixed (i.e. alignments along existing roads) and alignments that are schematic (i.e. alignments through large tracts of currently undeveloped land). Both the 'fixed' alignments and the schematic alignments may be changed during the design process. As a general rule-of-thumb, the length of collector sewer after construction (i.e., following actual subdivision streets) is typically about twice the length of the straight-line distance from the connection point to the trunk sewer to the farthest point in the sewershed. For this reason, it is desirable that a certain amount of flexibility be built into the trunk shed plan configurations. This flexibility can be represented by using slopes that are steeper than the minimum design slopes. Table 5 presents the 'flexibility factors' used to modify minimum design slopes to compute minimum trunk shed slopes. Table 6 presents the recommended minimum trunk shed slopes for 'fixed' (existing road) alignments and schematic (undeveloped land) alignments, compared to the minimum recommended design slopes.

Table 5: Basis of Minimum Trunk Shed Slopes (as Increase over Minimum Design Slope)

Diameter (in.)	Minimum Trunk Shed Slopes	
	Alignment in Existing Road	Alignment in Undeveloped Land
8 to 10	Increase 0.0002 (1 foot per mile)	▪ 8" Sewer: Increase 0.0025 (2.5 feet per 1,000 ft) ▪ 10" Sewer: Increase 0.0010 (1 foot per 1,000 ft)
12 to 18		Increase 0.0004 (2 feet per mile)
21 to 36	Increase 0.0001 (6-inches per mile)	Increase 0.0002 (1 foot per mile)

Table 6: Recommended Minimum Slopes

Diameter (in.)	Minimum Design Slope(2)	Minimum Trunk Shed Slopes		
		Alignment in Existing Road	Alignment in Undeveloped Land(3)	Design Flow at Minimum Slope (mgd) (1)
Collector Sewers				
8	0.0035	0.0037	0.0060	0.39
10	0.0025	0.0027	0.0035	0.59
12	0.0020	0.0022	0.0024	0.86
Trunk Sewers				
12	0.0020	0.0022	0.0024	1.03
15	0.0015	0.0017	0.0019	1.62
18	0.0012	0.0014	0.0016	2.35
21	0.0011	0.0012	0.0013	3.40
24	0.0010	0.0011	0.0012	4.63
27	0.0010	0.0011	0.0012	6.34
30	0.0010	0.0011	0.0012	8.39
33	0.0010	0.0011	0.0012	10.8
36	0.0010	0.0011	0.0012	13.6

(1) Based on minimum design slope, Manning's '*n*' =0.013, and full pipe for trunk sewers and d/D = 0.7 for collector sewers.

(2) Minimum design slope selected to provide a minimum velocity of 2 fps for sewers between 8 and 18 inches. For sewers between 21 and 36 inches the minimum slope allows the velocity to transition from 2 fps to 3 fps. Velocities calculated with Manning's '*n*' =0.013 and full pipe conditions. Slopes shown with two significant digits.

(3) Slopes shown for 8- and 10-inch sewers will be used to check minimum depth of sewer at periphery of trunk shed. Length will be measured on a straight line from trunk sewer to the periphery of the trunk shed. Sewers 12 inches and larger will be shown in the 'best guess' location of future roads in the trunk shed.

E. Maximum Velocity

As shown in Table 2, the maximum velocity used by various agencies generally ranges from 8 to 15 fps. For this Master Plan, a maximum velocity of 10 fps for gravity sewers is recommended.

F. Maximum Collector Sewer Depth

The City's Draft Improvement Standards do not address the maximum depth of sewer services or collector sewers. CSD-1 limits the maximum depth of sewer services to 16 feet which then limits the depth of collector sewers to 16 feet since sewer service lines connect to collector sewers. This restriction exists because the CSD-1 Maintenance and Operations group has the capability to make repairs to service lines and collector sewers to a depth of 16-feet with their own excavation and shoring equipment.

Excavations deeper than 16-feet require the M&O group to hire an outside contractor to perform the necessary repairs. Since most sewer repairs occur on service lines and collector sewers, it was logical for CSD-1 to limit collector sewers to a maximum depth of 16-feet. Following similar logic, we recommend that the maximum depth for service sewers and collector sewers in Winters be limited to 16 feet.

For trunk sewers (sewer 15-inch and larger and 12-inch sewers without service sewer connections), we recommend that the maximum depth be evaluated on a case-by-case basis. In general, a maximum cover of 20 feet can be used.

G. Minimum Pipe Depth

When discussing the depth of a pipeline, two terms are used: depth and cover. Sometimes these terms are used interchangeably, but for the purposes of this Master Plan, the following definitions will be used:

- Depth: Distance from ground surface to invert of pipe.
- Cover: Distance from ground surface to crown (top) of pipe.

The deeper a gravity sewer is located, the more flexibility there is with respect to alignment and connection point selection for future upstream connections. If a gravity sewer is too shallow, future upstream development using gravity connections may be restricted, and a lift station may be required. For this reason, it is important to plan sewers at proper depths during the master planning process. For this Master Plan, it is recommended that a minimum depth of 7 feet be used for planning future sewers, including the sewers at the periphery of the system. The following procedure will be followed to confirm that this minimum depth criteria is met:

1. Delineate trunk shed boundary.
2. Using existing features such as roads and property lines, create plan view of sewer system skeleton within the trunk shed.
3. Calculate design flows.
4. Using design flows, calculate pipe sizes and slopes.
5. Connect far corners of trunk shed to trunk sewer skeleton using a straight line at the trunk shed minimum slopes (this represents a collector sewer serving the future development at the periphery of the trunk shed.) Check minimum depth at far corners as well as at all other locations in the trunk shed.

Due to topographic features such as canals, creeks, etc., there may be locations where the minimum depth criteria cannot be met. This will be considered acceptable as long the following two conditions are satisfied:

1. The length of the reach of pipe at less than minimum depth is relatively short (less than about 50 feet).
2. There is at least 4 feet of separation between the flow line of the creek or canal and the crown of the sewer. The flow line elevations will be based on either field survey data or flow line information from the recent Winters Drainage Master Plans. USGS topographic maps are not accurate enough to determine flow line elevations of canals/creeks for this purpose.

During the final design phase, details such as concrete encasement, pipe material, flotation caps, creek restoration details, hydroseed mixes, manhole setback distances, and trench plugs will be determined based on Winters' Design Standards and the depth of sewer, diameter of sewer, length of crossing, and permit requirements.

H. Design Requirements at Increases in Pipe Size

As design wastewater flowrates increase from upstream to downstream, it is necessary to increase the size of the sewer pipe. Pipe size increases are only allowed at manholes. There are several methods that may be used to determine the relative vertical alignment of the upstream and downstream pipes at changes in pipe size:

1. Match the elevation of the energy grade lines of the two pipes at the design flowrate.
2. Match the crown elevations.
3. Match the 2/3 diameter points.
4. Match the 0.7 diameter points.
5. Match the 5/6 diameter points.

Method 1 is the most rigorous and is usually only used during final design. Methods 3, 4, and 5 are quick approximations of method 1. Method 2 is the most conservative and easiest to apply at the planning stage. Therefore for this Master Plan, method 2, matching crown elevations at pipe size increases, is recommended.

Same Size Branch Sewer Connections.

There may be locations in the collection system where two pipes of the same size connect together but the design flow in the branch pipe is significantly lower than that in the mainline pipe. At these locations, if the crown elevations are matched, the higher flow level in the main sewer will cause a backwater condition in the branch sewer. For this Master Plan, it is recommended that the branch sewer elevation be set 0.1 foot above the main sewer elevation when the branch sewer is the same size as the main sewer.

I. Headloss in Manholes

There are various approaches used to account for the headloss generated by manholes:

1. Every manhole (straight or deflection) is assigned a 0.1-foot drop.
2. Deflection manholes are assigned a minimum of 0.1-foot drop.
3. Calculation is made for each headloss component, including headloss due to change of direction, change of slope, and sidewall friction within the manhole, for pipelines with velocities greater than 3 fps.

Method 1 can be excessive except in areas with an abundance of available fall. Method 3 is too rigorous for a planning level analysis. For this Master Plan, Method 2 is recommended with these added clarifications: Deflection manholes with changes in direction greater than 20 degrees will be assigned a 0.1-foot drop. Deflections greater than 90 degrees are not allowed.

If a sewer increases in diameter in a deflection manhole, the invert elevation increases are not additive. For example, if two 12-inch sewers join in a manhole and discharge to an 18-inch sewer, the drop in invert elevation would be 0.5 feet (based on matching crowns), not 0.6 feet (0.5 feet + 0.1 feet for deflection).

J. Hydraulic Design Criteria for Force Mains

Pump stations and force mains should be avoided in sewage collection systems as much as possible but may become necessary to keep the collection system from becoming excessively deep. The hydraulic criteria for selecting the diameter of force mains are presented below.

Minimum and Maximum Velocities. Various agencies use different design criteria for velocities in force mains. Sacramento County is currently writing a Pump Station Design Manual. Table 7 presents the criteria from various agencies.

Table 7: Comparison of Force Main Velocity Criteria of Various Agencies

Agency	Force Main Velocity
Washington Suburban Sanitation District	▪ Maximum: 6 fps ▪ Minimum: 2 fps to keep solids in suspension, ▪ 3 to 3.5 fps to resuspend solids
City of Dallas	3 to 5 fps
City of Phoenix	3.5 to 6 fps

The maximum velocity in a force main is usually determined by balancing a number of factors including cost of the pipeline; cost of power usage (higher velocity results in higher headloss); and cost of pumps, motors, electrical equipment, and surge protection facilities. Given that the design flow rate for sewer force mains (PWWF at buildout) occurs infrequently, once every 10 years if the design storm is a 10-year storm, it is cost effective to set the maximum velocity at a high velocity since the daily peak flow rate is typically much lower. (For a typical water pump station, the daily flow rate is closer to the design flow rate, which tends to lower the cost effective maximum velocity for water transmission pipelines compared to sewage force mains.) For this Master Plan, a maximum force main velocity of 8 fps at PWWF is recommended.

Force mains connected to large pump stations (e.g., East Street Pump Station) flow constantly, whereas small pump stations, such as El Rio Villa pump station, pump intermittently, and the solids in the force mains can settle out during low flow periods as the wet well fills. This is especially true during the early startup years of a pump station before its upstream catchment area fully develops. To resuspend the solids that may settle out in the force main, a minimum velocity of 3.5 fps with one pump running is recommended for use in the Master Plan.

Most force mains are relatively flat and the 3.5 fps recommendation is applicable. A small number of pump stations pump uphill through force mains that are constructed on steep slopes. This adverse slope requires a higher sewage velocity to transport solids. Therefore, if a force main is steeper than 20 percent, additional analysis is required to determine the acceptable minimum velocity.

Dual Force Mains.

To obtain the required velocities for both initial and ultimate design flow conditions, dual force mains may be needed. Dual force mains also have the ability to allow for future inspection and rehabilitation of the pipes, which generally cannot be adequately inspected or repaired without being taken off line and dewatered for up to 24 hours at a time

In most cases, dual force mains can be built in two stages, since initial flows are generally significantly lower than design flows at buildout. However, building dual force mains in two stages may not be prudent in locations where available space may not be available in the future or in locations where one-time construction is strongly preferred to minimize impacts to the environment (e.g., wetlands), costly mobilization (e.g., highway and river crossings), or disturbance to the public.

For this Master Plan, it will be assumed that all pump stations will have dual force mains of the same size and that the second force main will be constructed 20 years after the initial force main. If a different method of dewatering the first force main is easily identified, only one force main is required. For example, for short force mains that do not cross railroads, freeways, or rivers, bypass pumping using temporary above ground piping for bypass pumping is an acceptable method. For long force mains, dual force mains are one solution, but other solutions are possible depending on the site. Each force main will be sized to carry half of the peak design flow at a maximum velocity of 8 fps.

Also, each force main must have sufficient capacity to carry the peak dry weather flow at buildout so that one force main can be dewatered and undergo inspection or rehabilitation. Since force main inspections and rehabilitation events are relatively rare, the maximum velocity criteria can be relaxed and increased to 10 fps for peak dry weather flows through a single pipe.

Headloss

The Hazen-Williams formula will be used for calculating the friction headloss of force mains. The Hazen-Williams roughness coefficient, C, varies with pipe material, velocity, size, and age. Sacramento County field studies have measured C factors ranging from 105 (Arden Pump Station 60-inch RCP force main) to 130 (Sailor Bar Pump Station 14-inch PVC force main). For this Master Plan, a roughness coefficient of C = 100 is proposed to be used for all pipe sizes and materials.

K. Inverted Siphons

The term siphon as used in wastewater practice refers to an inverted siphon or depressed sewer which dips below the hydraulic grade line to avoid obstructions and stands full of sewage even with no flow. Its purpose is to carry sewage under an obstruction and to regain as much elevation as possible after passing the obstruction. Inverted siphons should be avoided unless clearly necessary to cross under major obstructions such as rivers or large creeks, major utility pipelines, highways, etc., and other alternatives are significantly more expensive. Alternatives to inverted siphons include deeper gravity sewers and/or pump stations, a well as “D”-shaped or box sewers. There are currently no inverted siphons in the City of Winters’ sewer system, and it is generally the City’s preference to construct deeper sewers and/or pump stations to clear deep obstructions.

The approach used in this Master Plan when planning relief projects or future expansion projects will be to avoid inverted siphons whenever possible. If it becomes necessary to use an inverted siphon, the following approach will be used:

- The length of the downflow and upflow legs of the siphon will based on a maximum slope of 15 percent to allow floatables to be conveyed downward and solids to be conveyed upward. [source: City of Los Angeles Sewer Design Manual Figure F272]
- The upstream invert elevation will be calculated by adding 12 inches plus the pipe friction to the downstream invert elevation. (The 12-inch factor is a conservative factor used at the planning phase; during the design phase, detailed hydraulic calculations would be performed.)
- The pipe friction will be calculated using the Hazen-Williams formula with a ‘C’ coefficient of 100.
- The pipe barrel diameter will be determined based on the following three criteria [source: City of Los Angeles Sewer Design Manual]:
    - Minimum velocity of 3 fps at ADWF during early years of operation.
    - Minimum velocity of 4 fps at PDWF during early years of operation.
    - Minimum 8-inch pipe diameter.
- Two barrels will be assumed for each siphon.

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Technical Memorandum 1B2

City of Winters – Sewer System Master Plan

Subject: Wastewater Design Flow Criteria - FINAL

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I. Introduction

This Technical Memorandum (TM) presents the methodology used to develop wastewater flow estimates for the City of Winters' (City) Sewer Master Plan. The flow estimates, in conjunction with developed land use scenarios[1] and the sewer master planning criteria presented in a separate TM[2], will be incorporated into a steady state hydraulic model for analyses to determine existing and future deficiencies in the existing sewer collection system and will serve as the basis for sizing future pumping and conveyance facilities.

This TM is organized as follows:

I. Introduction
II. Summary of Recommended Wastewater Design Flow
III. Wastewater Flow Components
IV. Wastewater Design Flow Criteria
  A. Hydraulic Model
  B. Design Flow (PWWF)
    i. Average Dry Weather Flow (ADWF)
    ii. Peak Dry Weather Flow (PDWF)
    iii. Infiltration/Inflow (I/I)

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1 Two land use scenarios will be evaluated as part of the Winters Sewer Master Plan:
a. existing (dated based on aerial photos as September 2002), and
b. buildout (expected to occur in 2010 as referenced in the General Plan)

2 RMC, *DRAFT Sewer Collection Design Criteria for Master Planning TM 1B*, City of Winters - Sewer System Master Plan, October 20, 2003.

II. Summary of Recommended Wastewater Design Flow

A summary of the recommended wastewater design flow generation based on a steady state hydraulic modeling approach are presented as follows:

Design Flow = PWWF = PDWF + I/I

where **PDWF** (3) **= ADWF x PF**

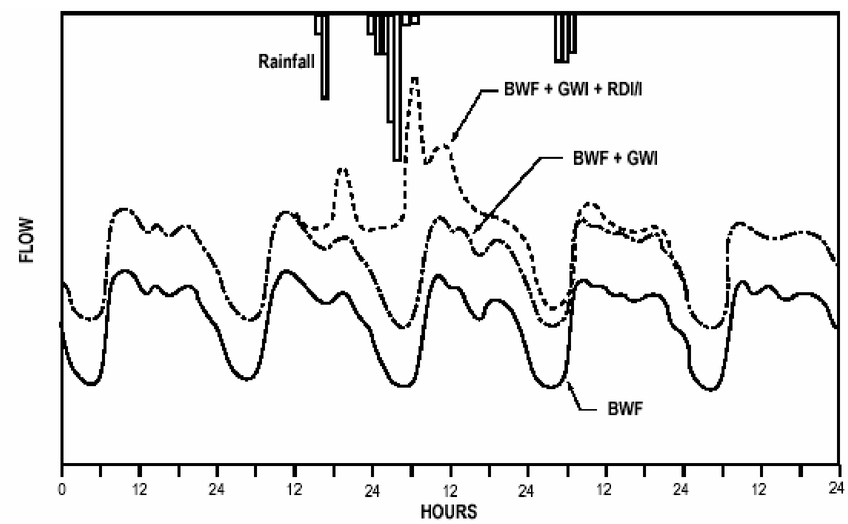
PF (4) **= 3**

I/I = 600 gallons per acre

III. Wastewater Flow Components

The basic components of wastewater flows are base wastewater flow (BWF) and infiltration/inflow (I/I). The wastewater components are described below and shown in Figure 1.

Figure 1: Wastewater Flow Components



BWF is generally defined as the combined sanitary and processed flow contributed by residential, commercial, industrial, and institutional users of the sewer system. BWF rates vary based on the land use category, the hour of the day, and the day of the week.

I/I is extraneous (i.e. non BWF) water that enters the sewer system. I/I includes groundwater infiltration (GWI) and rainfall-dependent I/I (RDI/I).

As the term GWI implies, GWI is groundwater that infiltrates the sewer collection system via cracks and defects in pipes, pipe joints, and sewer structures such as manholes. As such, the magnitude of GWI depends upon the age and physical condition of the sewer system as well as the relative elevation of the groundwater table with respect to the sewer system. GWI tends to decrease during the dry summer and fall months and increases during the wet weather season. However, since changes in the groundwater table occur relatively slowly (over a matter of weeks or months rather than hours), GWI rates can be considered constant over short durations.

In theory, BWF should not include dry weather GWI (or base infiltration). However, it is almost impossible, and not practical to accurately separate dry weather GWI from BWF based on actual measured flows. Therefore, the combination of BWF plus base infiltration is typically considered as a single component, termed average dry weather flow (ADWF). The term GWI is then primarily used to refer to the wet weather component of GWI, or the increase in GWI between the dry and wet weather season.

(3) Refer to Section IV.B for ADWF generation and Section IV.C for peaking factor (PF)

(4) Except for Park & Recreation parcels and El Rio Villa. The Parks & Recreation parcels generally have very low sewage generation factor and El Rio Villa Pump Station convey flows to the collection system at a constant rate. Hence, it is assumed that their flow will not vary significantly throughout the day (i.e. peaking factor = 1)

RDI/I is storm water that enters the sewer system in direct response to rainfall. RDI/I may enter the system directly by such means as cross-connections between the storm drain and sanitary sewer systems or through area drains and downspouts illegally connected to the sanitary sewer system. RDI/I may also enter the sewer system indirectly through sewer defects, particularly in shallow pipes such as private building laterals. RDI/I flows are directly related to the intensity and duration of rainfall, and generally rise quickly and recede very rapidly after the end of the storm. In addition to being dependent on rainfall, RDI/I is sensitive to soil moisture and tends to be most significant late in the wet season or after extended periods of rainfall when the soil is highly saturated.

IV. Wastewater Design Flow Criteria

To develop flow projections for the service area, flow estimating criteria were defined for each component of wastewater flows. For the purpose of this master plan, it was assumed that the design flow criteria will be the same for the existing and buildout land use scenarios. Hence, it is assumed that future sewage generation characteristics will not be affected by factors such as water conservations, increased in sewer system age, etc. The criteria for simulating hourly, weekday, and seasonal flow variations are typically defined by the type of hydraulic model used. The hydraulic model selection and design flow criteria are described in the following sections.

A. Hydraulic Model

There are two types of hydraulic models used to simulate a sewer collection system: 1) steady state/static simulation and 2) extended period/dynamic simulation. Simulations from a steady state model represent a snapshot of the system performance at a given point in time under specific sewage generation conditions (i.e. ADWF, PDWF, PWWF, etc.). The extended period model is a continuous simulation of the change in system flow rate and is typically used to analyze the operational performance of the system over a 24-hour period. Dynamic modeling requires more extensive data input, including various 24-hour sewage generation patterns (also known as diurnal curves or wastewater profiles) for various land use categories within the sewer collection system.

Extended period simulations are typically used to evaluate operational studies, whereas steady-state models are used for sizing of sewers and pump stations. Hence, for the purpose of this master plan, a steady-state hydraulic model will be used in the system analyses to size sewers and pump stations.

B. Design Flow (PWWF)

Sewer system facilities must be sized to convey the peak flows in the system. Typically, the peak flow occurs during a wet weather event, and is therefore termed the peak wet weather flow (PWWF). Since the design storm peak can occur at any time of the day, it was assumed for a steady-state model and conservative master plan criteria that the peak I/I flow would coincide with the peak dry weather flow (PDWF). The design flow or PWWF for any segment of the sewer system is therefore calculated using the following formula:

$$
\begin{aligned}
\text{Design Flow} &= \text{PWWF} \\
\text{PWWF} &= [\text{ADWF} * \text{PF}] + [\text{I/I}] \\
&= \text{PDWF} + \text{I/I}
\end{aligned}
$$

The PDWF is calculated by applying a peaking factor to the ADWF. The peak I/I flow is assumed to be constant at a rate of 600 gpd/net acre. The development of each of these flow components is discussed in detail in the following sections.

i. Average Dry Weather Flow (ADWF)

As described above, ADWF flowrates in the sewer system depend upon the type of land use and the day of the week. For the purposes of this study, the ADWF flowrates used in developing wastewater flow projections are assumed to represent BWF plus dry weather groundwater infiltration. Maps of the identified existing and buildout land uses are located in Attachment A[5]. The weekday flow variation shall be reflected in the peaking factor use for steady-state modeling analyses. A summary of the existing and buildout land use categories, densities, and ADWF is presented in Table 1.

Residential

Existing residential flows shall be generated based on a population method. Based on Section 7-2 of the City's June 2003 Draft Design Standards, a per capita flow factor of 90 gallons per day (gpcd) will be used along with the population density listed in the General Plan to generate flows for each developed residential parcel. Hence, existing residential ADWF flows is generated for each developed parcel using the following formula:

ADWF (gallons per day - gpd) = [Population Density]*[90 gpcd]

For vacant and existing developed high density residential area where more than one resident/house could be and are developed on each parcel, the flow will be generated based on an areal method using the unit areal flowrates (gpd/net acre)[6]. The proposed and 1992 Sewer System Master Plan areal ADWF factors are listed in Table 1 for comparison. Proposed residential areal ADWF factors were developed using the following formula:

ADWF Factor (gpd/net acre) = [Residential Density]*[Population Density]*[90 gpcd]

For existing scenarios, the residential density used for generating flows from existing developed high density residential parcels is the minimum density listed in the General Plan (i.e. 6.1 and 10.1 DU/acre for MHR and HR categories, respectively).

To be conservative, it is assumed that vacant residential parcels will be developed according to the maximum residential density allowed for each categories (i.e. 7.3 DU/net acre for LR, 20.0 DU/net acre for HR, 10.0 DU/net acre for MHR, etc.)

The population density used to generate existing flow for the Medium Density (MR) Residential Land Use category was reduced from 3.5 person/DU, as listed in the General Plan, to 3.0 person/DU to arrive at a more realistic total existing daily flow value for the City. The other option for reducing flow was to reduce the per capita design flow rate of 90 gpcd. Since flow data was not available to determine the actual per capita flow, it was decided to keep the conservative design rate of 90 gpcd for master planning purposes and reduce the population density for the MR category (the largest residential land use category) instead. With a population density of 3.0 persons/DU for MR category, the total daily flow for the City is 0.83 mgd as oppose to 0.88 mgd.

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[5] Land use maps were developed based on the following information/data:

1. Winters 1992 General Plan and subsequent Land Use Diagram and Zoning Map updates,
2. Aerial photos,
3. Yolo County Cooperative GIS Parcel Map layer, and
4. Inputs from the City of Winters Planning Division.

[6] Gross acreage includes all land (including streets and right-of-ways) designated for particular uses while net acreage, as defined in this master plan, excludes streets/roadways. Winters' urban limit line contains approximately 1980 gross acres *(http://www.cityofwinters.org/profile/geography.html)*. As shown in Table 3, the net acreage (i.e. excluding roadways) is 1,782 acres, which is approximately 90 percent of the gross acreage.

By counting existing occupied residential parcels and using the residential and population density values used in generating the existing residential flows, the estimated existing (as of September 2002) population for the City is 5,608 people. If a population density of 3.5 person/DU was used for the MR category, the estimated existing population would be increased to 6,160 people. The population estimate provides a reality check for the residential flow assumption. Since the population of Winters was estimated by the California State Department of Finance[7] to be 6,300 for 2002, the population estimate confirms that the methodology proposed to generate existing residential flow is a very reasonable and realistic approach.[8]

Commercial, Industrial, and Others

Non-residential flows shall also be generated based on an areal method for different land use categories in the City's Draft Design Standards. Commercial, industrial, and other ADWF factors are defined in the City's Draft Design Standards. These proposed values are also listed in Table 1 along with values used in the 1992 Sewer Master Plan. For the most part, except for the Planned Commercial and Heavy Industrial categories, the proposed ADWF factor and those used in the 1992 Sewer System Master Plan are identical to each other.

According to the General Plan, the standards of building intensity for non-residential uses are stated as maximum floor-area ratios (FARs) based on net acreage. A FAR is a ratio of the gross building area zoned for a particular usage category to the net area of the parcel. Per conversation with the City, a FAR of 1.0 shall be applied for all non-residential parcels in calculating the proposed ADWF factor for the purpose of this master plan.

Public/Quasi-Public.

Various locations within the City are zoned public/quasi-public (PQP) and are shown Map 3 in Attachment A. PQP areas include a variety of areas including schools, parks, City Hall, and detention basins. For this master plan, the applicable sewage generation calculation will be determined on a case by case basis for each PQP area with schools being treated as point sources. Table 2 is a listing of the sewage generation flowrates for each PQP location.

Large Dischargers

Flows from large dischargers, such as major industries and large institutions, are treated as point sources in developing system wastewater flows since they cannot be accurately estimated using the typical areal unit flowrates described above. For this master plan, the Mariani Nut and Fruit Company and El Rio Villa have been identified as the only large dischargers for the City.

The Mariani facility is located to the east of Railroad Avenue from Anderson Avenue to Abbey Street. Based on examination of aerial photography, it appears that the main processing area is located north of Grant Avenue between Dutton Street and Walnut Lane. This three acre parcel is assumed to generate 100 gpm (0.144 mgd) of ADWF. The dry weather peaking factor of 3 will also be applied to the Mariani facility (PDWF = 300 gpm or 0.432 mgd). This ADWF correspond to an areal flowrate of 48,000 gpd/acre. This flowrate assumption can be modified as necessary as the City collects additional flow data from the Mariani facility.

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[7] http://www.dof.ca.gov/HTML/DEMOGRAP/E-1text.htm

[8] The population estimate generated by the same method for the buildout scenario is 18,320 people. This is approximately 4,000 more people than the estimated buildout population from the General Plans since the maximum residential density was assumed for all vacant residential parcels and future residential roads has not been taken into account. However, this conservative approach is acceptable for master planning purposes.

El Rio Villa is a small subdivision located approximately 0.7 miles east and outside of the City's urban limit boundary. The City has a contract with Yolo County to convey and treat the sewage from El Rio Villa and there are no plans to increase the size of this small subdivision. Wastewater from El Rio Villa is collected and pumped to the City's sewer collection system via the El Rio Villa Pump Station (ERVPS).

The ERVPS is a two-stage pump station consisting of two pairs of pumps. Each pair of pumps can pump 155 gpm. It is assumed that one of the pairs of pumps provides stand-by capacity. Flow data from the ERVPS indicated that on an average dry day, the pumps are activated approximately 50 times a day for a minute or two each time. Therefore, even though the pump station only pumps 12,000 gallons on an average dry weather day (equivalent to 8.3 gpm), the sewer system must be capable of conveying a flowrate of 155 gpm.

Further downstream in the sewer system, it may be possible to reduce the impact of this short duration peak flow as the peak is attenuated. For example, the impact of the flow from the ERVPS on the East Street Pump Station is closer to 10 gpm than 155 gpm. This reduction of impact will be evaluated on a case-by-case basis during modeling.

Estimated ADWF Flows

Table 3 presents the existing and buildout ADWF generated for the City based on the methodology discussed above. The existing and buildout ADWF generated is approximately 0.83 mgd and 2.91 mgd, respectively[9]. The ADWF value of 0.83 mgd for existing condition is a reasonable assumption and validates the proposed methodology since the average daily flow at the treatment plant is 0.83 mgd[10]. The ADWF projection of 2.91 mgd for the buildout land use scenario is a conservative value assuming that the maximum density allowed by the General Plan would be implemented and is a reasonable assumption for master planning purposes.

[9] Does not include flows from El Rio Villa.
[10] Larry Walker Associates, *City of Winters Sewer Master Plan Update – Wastewater Treatment Facilities*, December 2000.

Table 1: Existing and Buildout Land Use Categories, Residential Densities, and Current and 1992 ADWF Factors

LAND USE CATEGORIES	CODE	ZONING DESIGNATION	CODE	EXISTING & BUILDOUT DENSITIES		PROPOSED ADWF FACTOR [e] (gpd/net acre)	1992 ADWF FACTORS (gpd/acre)
				Residential Density [a] (DU/net acre)	Population Density [c] (Person/DU)		
Residential							
Rural	RR	Rural	RR	0.5 - 1.0	3.5	**315** [f]	500
Low Density	LR	Single Family (7,000 SF Ave. Min.)	R-1	1.1 - 7.3	3.5	**2,300** [f]	1,500
Medium Density	MR	Single Family (6,000 SF Ave. Min.)	R-2	5.4 - 8.8	3.0 / 3.5 [d]	**2,772** [f]	2,000
Medium/High Density	MHR	Multi-Family	R-3	6.1 - 10.0 [b]	3.0	**1,647 / 2,700** [b,f]	2,500
High Density	HR	High Density Multi-Family	R-4	10.1 - 20.0 [b]	3.0	**2,747 / 5,400** [b,f]	3,500
Commercial				N/A	N/A		
Neighborhood	NC	Neighborhood	C-1			**2,500**	2,500
Central Business District	CBD	Central Business District	C-2			**3,500**	3,500
Highway Service	HSC	Highway Service	C-2			**2,500**	2,500
Planned	PC	Planned	P-C			**2,500**	2,000
Planned/Business Park	PC/BP	Planned/Business Park	PC/BP			**2,500**	2,500
Industrial							
Light	LI	Light	M-1			**2,000**	2,000
Heavy	HI	Heavy	M-2			**5,000**	3,000
Other							
Agriculture	AG	General Agriculture	A-1			**0** [g]	n/a
Office	OF	Office	O-F			**2500**	2500
Public/Quasi-Public	PQP	Public/Quasi-Public	PQP			**Varies** [h]	Varies
Parks & Recreation	PR	Parks & Recreation	PR			**200**	200
Open Space	OS	Open Space	OS			**0**	n/a

[a] The Residential Density use for future residential developments on vacant parcels for the Sewer Master Plan shall be the densest allowed in the General Plan.
[b] The Residential Density used for MHR and HR parcels under existing condition is 6.1 and 10.1 DU/net acre, respectively.
[c] Based on Section 7-2 of Winters Draft Design Standards.
[d] The Population Density used for MR parcels under existing condition is 3.0 person/DU
[e] Per conversation with the City, a FAR of 1.0 shall be applied for all non-residential parcels in calculating the proposed ADWF factor for the purpose of this master plan.
[f] Residential ADWF for each occupied/non-vacant parcel = [Population Density]*[90 gpcd]
Residential ADWF Factor for each vacant and occupied MHR and HR parcels = [maximum Residential Density] * [Population Density] * [90 gpcd].
[g] Assumed Agriculture parcels are using septic tanks and are not connected to the sewer collection system
[h] ADWF for PQP parcels will be evaluated on a case by case basis, refer to Section IV.C for more discussion and Table 2 for more information.

Table 2: ADWF for PQP Parcels

PQP PARCEL	DESCRIPTION	EXISTING ADWF [a] (gpd)	BUILDOUT ADWF [a] (gpd)	EQUIVALENT LAND USE [b]	COMMENT
1	Shirley Rominger Intermediate School	18,000	35,000 [c]	N/A	Existing = 360 students Buildout = 700 students
2	Winters Middle School	23,000	30,000 [c]	N/A	Existing = 460 students Buildout = 575 students
3	Cemetery	7,200	7,200	N/A	Small office facility.
4	Detention Basin	0	0	N/A	
5	Waggoner Elementary School	35,000	35,000 [d]	N/A	Existing = 700 students Buildout = 700 students Assumed connection at Grant Ave.
6	Well #3	0	0	N/A	
7	John Clayton Kinder School	10,000	25,000 [d]	N/A	Existing = 200 students (10,000 gpd) Buildout = 200 students (10,000 gpd)
8	Winters High School	37,620	45,000 [e]	N/A	Existing = 627 students Buildout = 700 students Assumed connection at Railroad Ave (90% of flow - gym) Grant Ave. (10% of flow - admin.)
9	City Hall / Police Dept	3,500 gpd/net acre	3,500 gpd/net acre	CBD	
10	Yolo County Library	3,500 gpd/net acre	3,500 gpd/net acre	CBD	
11	Fire Department	3,500 gpd/net acre	3,500 gpd/net acre	CBD	
12A	Park/Community Center	3,500 gpd/net acre	3,500 gpd/net acre	CBD	Sewage generation is highly variable and is assumed to be equivalent to CBD parcels
12B	East Street Pump Station	0	0	N/A	
13	Corporation Yard	3,500 gpd/net acre	3,500 gpd/net acre	CBD	Sewage generation is highly variable and is assumed to be equivalent to CBD parcels
14	Winters School District	0	6,000 [f]	N/A	Existing = 0 students Buildout = 100 students

PQP PARCEL	DESCRIPTION	EXISTING ADWF [a] (gpd)	BUILDOUT ADWF [a] (gpd)	EQUIVALENT LAND USE [b]	COMMENT
15	Future Elementary School	0	35,000 [d]	N/A	Existing = 0 students Buildout = 700 students
16	Future Fire Station	0	3,500 gpd/net acre	CBD	
17	Future High School	0	60,000 [e]	N/A	Existing = 0 students (0 gpd) Buildout = students (60,000 gpd)
18	Landfill (closed) and Future Park	0	900	PR	Parcel is approximately 30 acres. 75% of parcel will be a park, 25% of the parcel will not be developed.
19	Future City Facility	0	30,000	NC OF	The future use of this 30 acre site is unknown. Assume future sewer generation equivalent to NC and OF parcels.
20	Wastewater Treatment Plant	0	0	N/A	

[a] Rounded to the nearest 1,000
[b] For modeling purposes. The equivalent Land Use categories and their codes are shown in Table 1.
[c] From the City's Design Standards, ADWF = 50 gpd/student, but not less than 30,000 gpd at buildout
[d] From the City's Design Standards, ADWF = 50 gpd/student, but not less than 25,000 gpd at buildout
[e] From the City's Design Standards, ADWF = 60 gpd/student, but not less than 45,000 gpd at buildout
[f] From the City's Design Standards, ADWF = 60 gpd/student

Table 3: Land Use Categories and Existing and Buildout ADWF Flows

LAND USE CATEGORIES	CODE	EXISTING LAND USE		BUILDOUT LAND USE	
		TOTAL NET ACREAGE [a]	TOTAL ADWF (gpd)	TOTAL NET ACREAGE [a]	TOTAL ADWF (gpd)
Residential					
Rural	RR	0	0	47	14,800
Low Density	LR	89	138,000	299	662,300
Medium Density	MR	196	284,600	314	631,000
Medium/High Density	MHR	16	27,000	69	177,100
High Density	HR	15	41,400	41	188,600
Sub-Total		***316***	***491,000***	***770***	***1,673,800***
Commercial					
Neighborhood	NC	4	9,800	22	55,100
Central Business District	CBD	46	162,100	63	220,000
Highway Service	HSC	1	2,200	6	13,900
Planned	PC	0	0	24	58,900
Planned/Business Park	PC/BP	0	0	54	136,200
Sub-Total		***51***	***174,100***	***169***	***484,100***
Industrial					
Light	LI	0	0	65	129,600
Heavy	HI	0	0	37	186,300
Sub-Total		***0***	***0***	***102***	***315,900***
Other					
Agriculture	AG	0	0	4	0
Office	OF	4	11,200	5	13,200
Public/Quasi-Public	PQP	280	150,300	399	390,700
Parks & Recreation	PR	14	1,900	145	30,300
Open Space	OS	49	0	188	0
Vacant	VC	1068	0	n/a	n/a
Sub-Total		***1,415***	***163,400***	***741***	***434,200***
	TOTAL	**1782**	**0.83 mgd**	**1782**	**2.91 mgd**

[a] Net acreage exclude streets and roadways. Winters' urban limit line contains approximately 1980 gross acres. For this master plan, the existing net acreage is approximately 90 percent of the gross acreage. For a conservative analysis, it is assumed that the net acreage will not decrease for the buildout scenario even though more residential roads will be built within existing vacant parcels.

ii. Peak Dry Weather Flow (PDWF)

Base wastewater flows vary throughout the day, with peak flow periods typically occurring in the morning and early evening hours. The ratio between these daily peak flowrates and the average flowrates is generally expressed as a peaking factor:

Peak Dry Weather Flow = [Average Dry Weather Flow] x [Peaking Factor]

or PDWF = ADWF x PF

Peaking factors are often developed based on dry weather flow monitoring data for steady state hydraulic simulation. Since the City does not have any current flow monitoring data, a peaking factor of 3 will be used in this master plan.[11] The peaking factor will be applied to all land uses except for Parks & Recreation parcels. Parks & Recreation parcels will use a peaking factor of 1 since these parcels do not normally experience a significant change in flow like other land use categories.

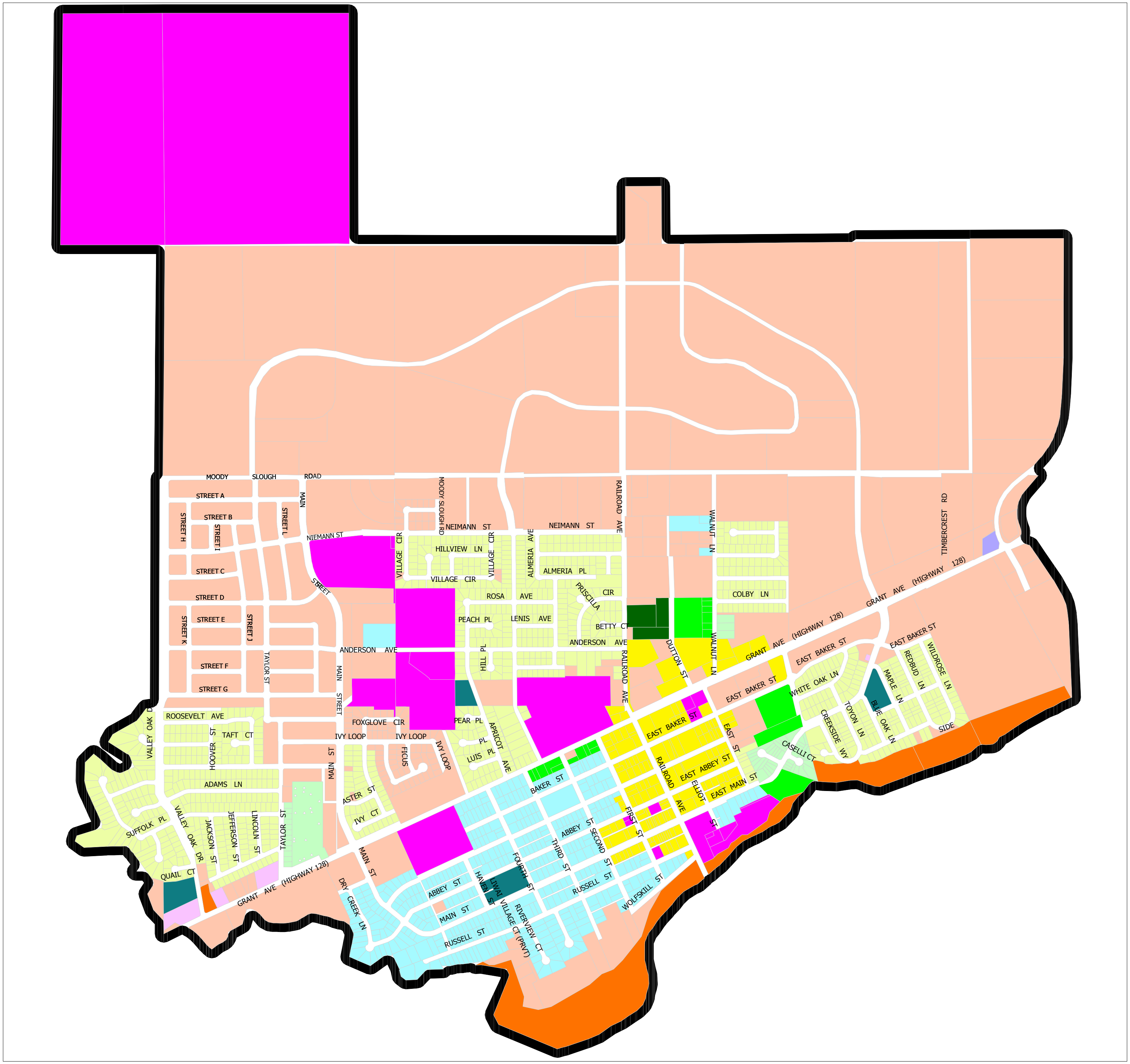
In large collection systems, the peak flows are attenuated as the flows move downstream. This is partly due to the difference in travel times of the various sewersheds (i.e. the peaks do not arrive at the same time). However, for the purpose of steady state modeling and since the size of the City's sewer collection system is relatively small, it is reasonable and conservative to assume that all the peaks will arrive at the same time to size conveyance and pumping facilities accordingly.

iii. Infiltration/Inflow Rates (I/I)

Peak wastewater flows typically occur during wet weather events as a result of rain-induced I/I. For this master plan, an areal I/I rate of 600 gpd/net acre will be used.[12] The Winters Draft Design Standards does not currently address this topic, but based on conversations with City staff, 600 gal/net acre will be included in the final version of the Design Standards. This I/I value of 600 gpd/net acre is consistent with the City of Woodland's Design Standards.

[11] The 1992 Sewer System Master Plan has estimated peaking factor that vary from 2.3 to 4.0 for the City.
[12] The 1992 Sewer System Master Plan did not reference an I/I rate.

ATTACHMENT A



LEGEND

Urban Limits

Existing Land Use

- Central Business District (CBD)
- High Density Residential (HR)
- Highway Service Commercial (HSC)
- Low Density Residential (LR)
- Medium/High Density Res. (MHR)
- Medium Density Residential (MR)
- Neighborhood Commercial (NC)
- Office (OF)
- Open Space (OS)
- Public/Quasi-Public (PQP)
- Parks & Recreation (PR)
- Undeveloped/Vacant

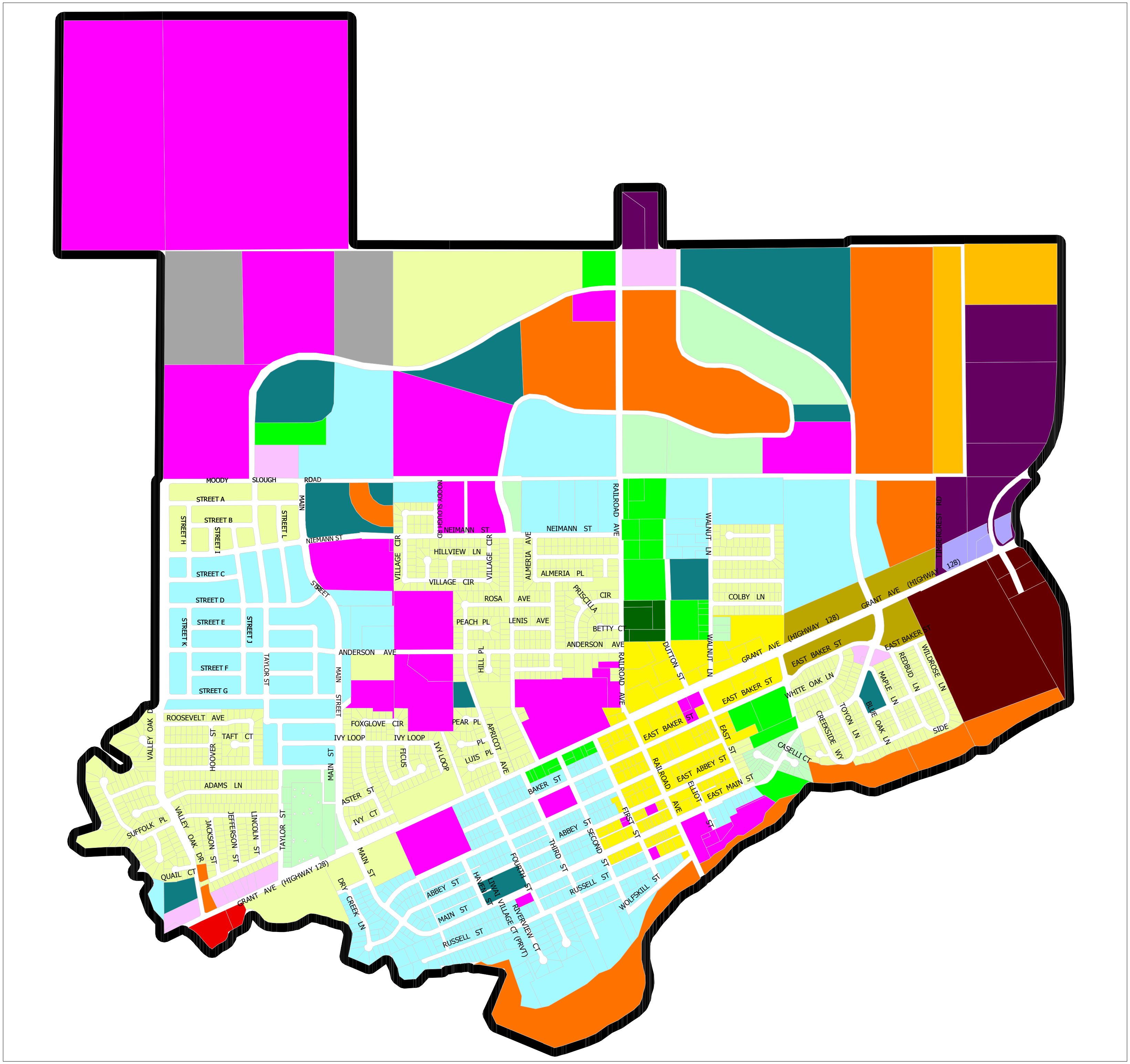
Map 1

Existing Land Use (as of Sept. 2002)

CITY OF WINTERS
Sewer Master Plan

N

0 0.2 0.4 Mi



LEGEND

Urban Limits

Buildout Land Use

- Agriculture (AG)
- Central Business District (CBD)
- Heavy Industrial (HI)
- High Density Residential (HR)
- Highway Service Commercial (HSC)
- Light Industrial (LI)
- Low Density Residential (LR)
- Medium/High Density Res. (MHR)
- Medium Density Residential (MR)
- Neighborhood Commercial (NC)
- Office (OF)
- Open Space (OS)
- Planned Commercial (PC)
- Planned Commercial/ Business Park (PC/BP)
- Public/Quasi-Public (PQP)
- Parks & Recreation (PR)
- Rural Residential (RR)

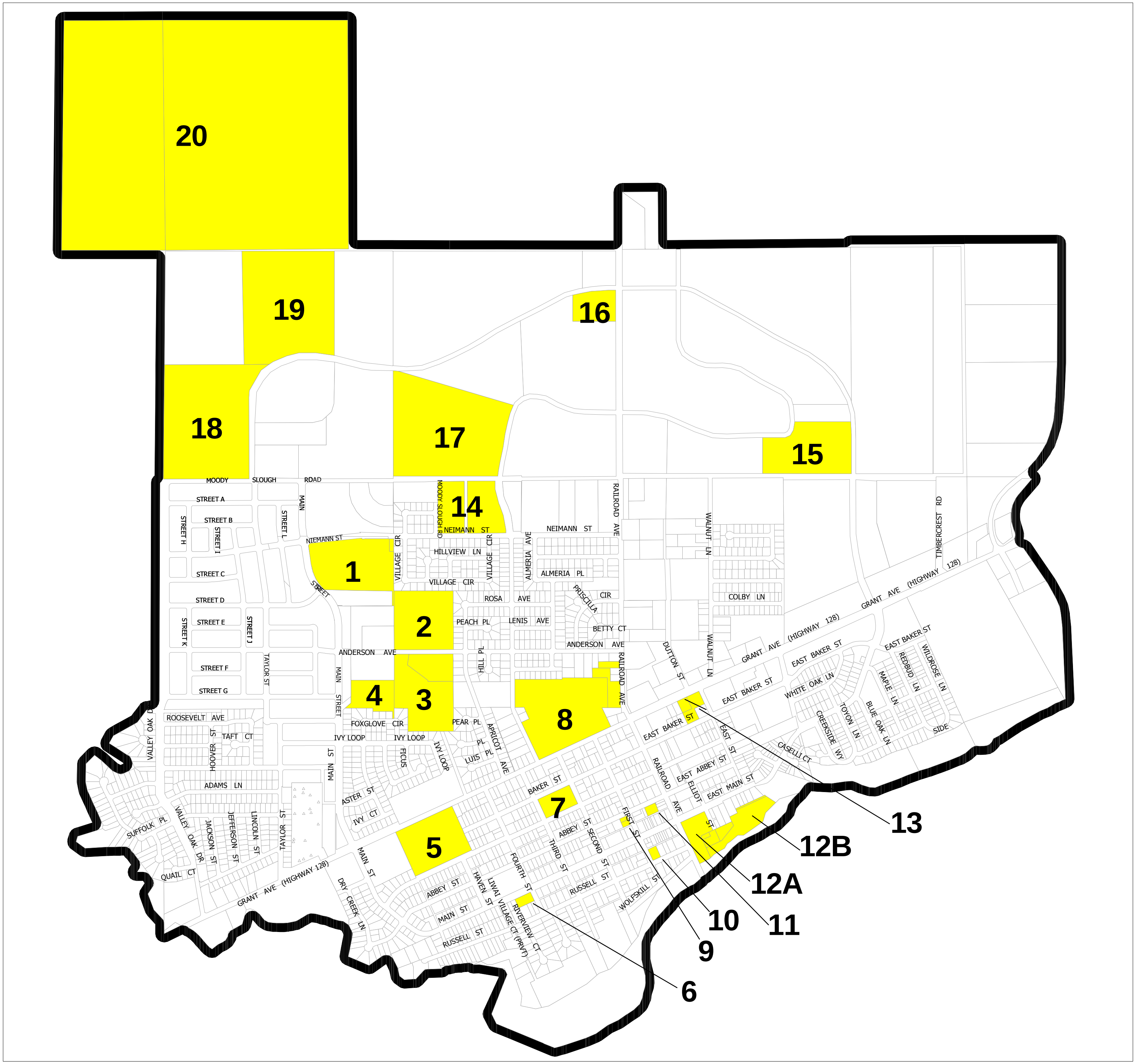
Map 2

Buildout Land Use (2010)

CITY OF WINTERS
Sewer Master Plan

N

0 0.2 0.4 Mi



LEGEND

Urban Limits

PQP Parcels

1 Shirley Rominger Int Sch
2 Winters Middle Sch
3 Cemetary
4 Detention Basin
5 Waggoner Elem Sch
6 Well #3
7 John Clayton Kinder Sch
8 Winters High Sch
9 City Hall/ Police Dept
10 TBD
11 Fire Dept
12A Park/Community Center
12B East Street Pump Station
13 Corporation Yard
14 Winters School District
15 TBD
16 TBD
17 TBD
18 Old City Landfill
19 TBD
20 Wastewater TP

Map 3

Public/Quasi-Public Parcels

CITY OF WINTERS
Sewer Master Plan

N

0 0.2 0.4 Mi

Technical Memorandum

City of Winters – Sewer System Master Plan

Subject: Evaluation of Routing Options for the Carter Ranch Pump Station

Prepared For: Michael Karoly, PE - City of Winters

Prepared By: Mai-Tram Le, P.E.

Reviewed By: Glenn E. Hermanson, P.E.
Lou Carella, P.E.

Date: May 5, 2004

Reference: 098.0024

In the future, there will be two major sewersheds in the City of Winters. One sewershed will flow south to the existing East Street Pump Station (PS); the other will flow north to the future Railroad Pump Station. The purpose of this TM is to determine which sewershed should include the Carter Ranch Pump Station (CRPS) in the short and long term.

The existing Carter Ranch development and the future Callahan and Ogando Hudson developments all drain to the CRPS. The buildout peak wet weather flow from the CRPS is 0.7 mgd. Three flow routing alternatives were evaluated for the CRPS as follows:

1. CRPS flows permanently south to the East Street PS
2. CRPS flows temporary south to the East Street PS and will be rerouted north to the future Railroad PS when Winters Highland is developed
3. CRPS flows permanently north to the future Railroad PS

Various existing and future sewer collection components will be impacted depending on which sewershed the flow is pumped to. A list of components, impacts, and associated costs are presented in Table 1.

The long-term plan, as recommended in TM 2B & 3B of the 2004 Sewer Master Plan, if development schedule was not an issue, would be to route flow north through Winters Highlands to the future Railroad PS (alternative #3) since it is the lowest cost alternative.

If Winters Highlands is not developed at the same time as the Callahan and Ogando Hudson Estates developments, the City would have the option of selecting between the two remaining alternatives (alternative #1 and #2) to route the CRPS flow south. Neither alternative #1 nor alternative #2 is dependent on the construction of Winters Highlands and therefore be implemented immediately. Both of these alternatives have essentially the same cost. The total costs are essentially the same because the cost for components 8 and 9 are essentially the same and one is used in alternative #1 and the other is used in alternative #2.

Table 1: Comparison of Sewer Routing Options for the Carter Ranch Pump Station

COMPONENT		BUILDOUT SCENARIO FOR CALLAHAN & OGANDO HUDSON ESTATES					
		Flows South to East Street PS		Initially Flows South then in the Future Flows North [a]		Flows North through Winters Highlands to Railroad PS	
1	East Street PS Capacity	Upgrade to 5.0 mgd	$989	Upgrade to 4.3 mgd	$824	Upgrade to 4.3 mgd	$824
2	East Street PS SCADA	Install	$75	Install	$75	Install	$75
3	East Street PS Standby Power	450 HP	$200	360 HP	$170	360 HP	$170
4	East Street PS Forcemain to future Railroad PS	5,000 feet of 14-inch	$814	5,000 feet of 14-inch	$814	5,000 feet of 14-inch	$814
5	Future Railroad PS Capacity	4.8 mgd	$1,428	5.4 mgd	$1,552	5.4 mgd	$1,552
6	Conveyance through Winters Highlands	No Action	$0	Construct	$65	Construct	$65
7	Carter Ranch PS Capacity	Expansion to 0.7 mgd	$84	Expansion & Flow Reroute	$127	Expansion & Flow Reroute	$84
8	Carter Ranch PS Forcemain to Neimann Street	No Action	$0	4,000 feet of 10-inch	$551	4,000 feet of 10-inch	$551
9	Grant Avenue/East Street Main	Reroute some flow via Railroad/Abbey	$534	No action - surcharge is not long-term	$0	No action	$0
10	Grant Avenue Sewer	Rehabilitate if sewers are in bad shape	$854	Rehabilitate if sewers are in bad shape	$854	No extensive rehabilitation required	$0
11	Connection between Grant Avenue Sewers at CRPS	Construct	$17	Construct	$17	No Action	$0
	TOTAL	**$5.0 Million [b]**		**$5.0 Million [b]**		**$4.1 Million**	

Notes:

1. Costs are rounded up to the nearest $1,000.
2. Cost estimates are at planning level and include typical contingency for planning level estimation (e.g. planning and engineering design, construction administration and management, environmental assessments and permits, administration costs, and legal fees).
3. SFENR CCI 7997.

Footnotes:

a. Scenario assumes Winters Highland will be developed before the East Street PS exceeds upgraded firm capacity of 4.3 mgd.
b. Cost might be less depending on the condition of the Grant Avenue sewers (Component #10).

Technical Memorandum

City of Winters – Sewer System Master Plan

Subject: Hydraulic Evaluation for Proposed Ogando Hudson & Callahan Estates Developments

Prepared For: Michael Karoly, PE - City of Winters

Prepared By: Mai-Tram Le, P.E.

Reviewed By: Glenn E. Hermanson, P.E.

Date: April 20, 2004 (FINAL)
March 22, 2004 (DRAFT)

Reference: 098.0023

As part of the Supplemental Contract for the City of Winters' (City) Sewer Master Plan Project, RMC is tasked with reviewing and evaluating the proposed development projects commonly known as Ogando Hudson and Callahan Estates for impact on the sewer collection system. Shown in Figure 1, the Ogando Hudson and Callahan Estates developments are located on the west side of the City. This area is currently undeveloped and zoned for single family homes with an average minimum lot size of 7,000 square feet. The current proposal from developers includes developing the area into low density residential homes consistent with the current zoning designation. In addition, Ogando Hudson and Callahan Estates propose to have the sewage generated by the new homes/developments drain to the existing Carter Ranch Pump Station which ultimately connects to the existing 8-inch and 10-inch sewer main along Grant Avenue. Hence, this technical memorandum (TM) discusses the hydraulic impact of the proposed development on the existing sewer system, especially on the Carter Ranch Pump Station and Grant Avenue sewers, along with recommendations for resolving identified deficiencies.

The TM is organized as follows:

I. Summary
II. Sewer Collection System Analysis & Recommendations
III. Cost Estimates

I. Summary

The proposal for sewage flows from the Ogando Hudson and Callahan Estates developments to be carried by Grant Avenue to the East Street Pump Station is feasible provided that four rehabilitation and expansion projects be constructed to expand and mitigate for increased flows in the sewer collection system. The four projects, estimated to cost a total of $1.5 million, are shown in Figure 2 and are as follow:

1. Enlarge Carter Ranch Pump Station.
2. Upsize & rehabilitate the existing 8-inch sewer on Grant Avenue.
3. Interconnect Grant Avenue parallel sewers at Main Street.
4. Construct Relief Sewer from Railroad Avenue/East Abbey to Main Street.

II. Sewer Collection System Analysis & Recommendations

Based on proposed development maps, land use information, and flow generation criteria used in developing the City's Sewer Master Plan (Sewer Plan), the proposed Callahan Estates development is projected to generate 32,400 gpd and 107,600 gpd of sewage during average dry (ADWF) and peak wet weather flow (PWWF), respectively.[1] The Ogando Hudson development is projected to generate 30,600 gpd and 100,600 gpd of sewage during ADWF and PWWF, respectively

Project 1 - The Carter Ranch Pump Station was built in 2001 to serve the Carter Ranch Development located southeast of the Callahan Estates. This 125 gpm duplex pump station has two constant speed, 3.0 horsepower pumps. With the addition of flows from the Callahan Estates and Ogando Hudson developments, the PWWF at the Carter Ranch Pump station is 487,000 gpd (340 gpm). Hence, the 125 gpm Carter Ranch Pump Station will need to be enlarged to 340 gpm to accommodate proposed flows. The existing wet well could most likely accommodate 340 gpm duplex pumps. Therefore, the expansion of Carter Ranch Pump Station would include new pumps and modification to the existing control panels and electrical equipments.

Figure 2: Proposed Modification for the Sewer Collection System

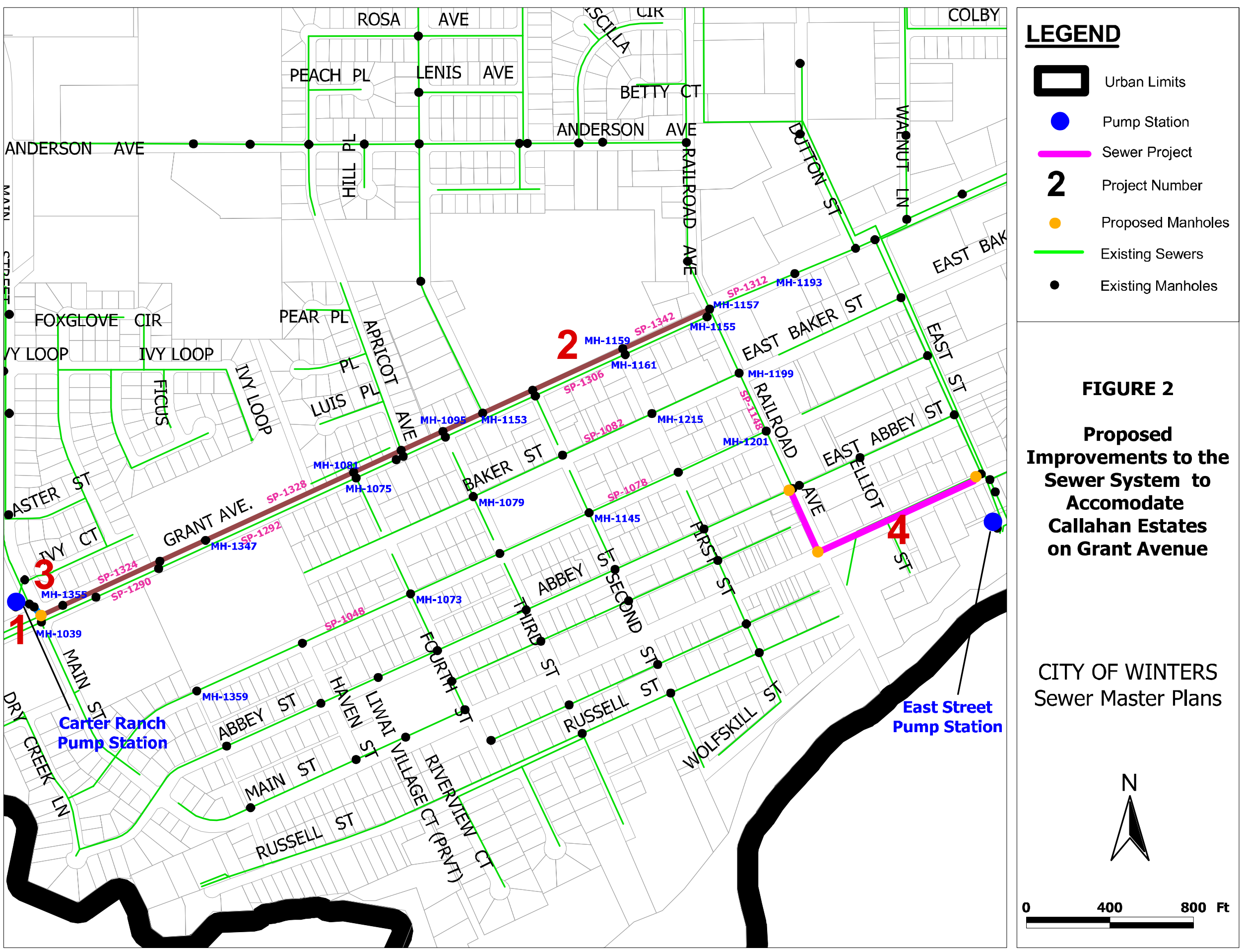


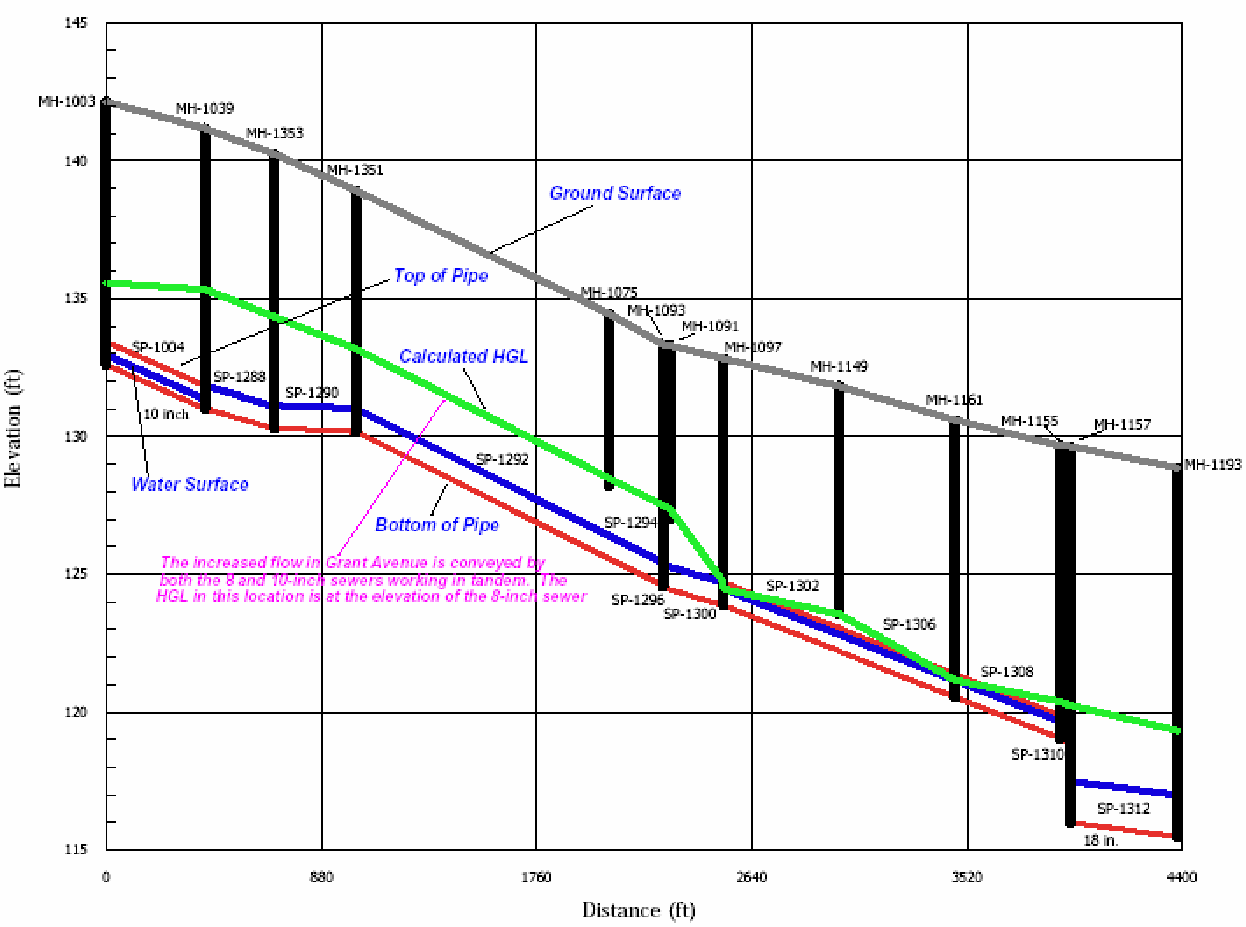
Figure 2 shows the sewer collection system from Carter Ranch Pump Station to the East Street Pump Station and the recommended projects. Carter Ranch Pump Station currently discharges flows to a 10-

[1] PWWF = (ADWF*PF) + I/I. PWWF is also known as the design flow. For more discussion on flow factors and definition, refer to TM 1B2 of the Sewer Master Plan.

inch sewer on Grant Avenue. The 10-inch sewer on Grant Avenue is paralleled by an 8-inch sewer on the north side of the street. The elevation of the 8-inch sewer is higher than the 10-inch sewer by approximately 2 feet. The 8-inch sewer drains into the 10-inch sewer at three connecting locations: 1) east of Cemetery Road, 2) Apricot Avenue, and 3) east of Hemenway Street. At Railroad Avenue, the parallel sewers connect to an 18-inch sewer.

Project 2 - Figure 3 presents the hydraulic profile for the 10-inch Grant Avenue sewer under PWWF conditions. Hydraulic analysis with the City's H2OMap Sewer model showed that the existing parallel sewers in Grant Avenue can not convey the increased flow from the Ogando Hudson and Callahan Estates developments without surcharging the 10-inch sewer. The flow can be conveyed by allowing the 10-inch sewer to surcharge to the elevation of the 8-inch sewer, which then allows sewage to flow from the 10-inch to the 8-inch sewer as shown in Figure 2. This surcharging is acceptable provided that both of the parallel sewers are in good operating condition since the 10-inch sewer is dependent on the capacity of the 8-inch parallel sewer to carry the excess surcharged flows.

Figure 3: Profile for Grant Avenue 10-inch Sewer



The 8-inch sewer on Grant Avenue is one of the oldest sewers in the City and there is no documentation available on its current condition. One reason why the 10-inch Grant Avenue sewer was constructed and all flows were diverted from the 8-inch sewer to the newer 10-inch sewer could be due to the deteriorating condition of the sewer. Since the structural condition of the 8-inch sewer is unknown and may not be in good operating condition and since the 10-inch sewer is dependent on the capacity of the 8-inch parallel sewer to carry the excess surcharged flows from the proposed developments, it is conservatively recommended that the 8-inch segment from Main Street to Railroad Avenue be rehabilitated.

The rehabilitation of 3,525 feet of 8-inch Grant Avenue sewer is shown as project number 2 in Figure 3. With Grant Avenue being a major roadway for the City, the least disruptive and most cost effective method to rehabilitate the 8-inch sewer would be to use a trenchless construction method and pipe burst the existing sewer with a 10-inch nominal diameter, DR 13.5 pressure class rating HDPE (high density polyethylene) pipe.[2] Prior to designing the rehabilitation work, it is recommended that the condition of both the 8-inch and 10-inch Grant Avenue sewers be evaluated using CCTV inspection methods to confirm the need for a rehabilitation project. The inspection process would also help to identify which segments along the 3,525 feet stretch require improvements since it might not be necessary to replace all 3,525 feet.

Project 3 - In addition to the rehabilitation of the 8-inch Grant Avenue sewer, it is recommended that an additional connection point be created to link the 10-inch and 8-inch sewers to allow sewage to flow between the sewers. The location of this new connection point is downstream of the Carter Ranch Pump Station at the intersection of Grant Avenue and Main Street. The connecting sewer would be installed from MH-1693 at an elevation of invert 134.8 feet (upstream of MH-1039 on Main Street) to a new manhole constructed for the 8-inch sewer at the Grant Avenue/Main Street intersection at an elevation of 134.7 feet. This new connection will serve to prevent potential overflow due to surcharge in the 10-inch sewer line shown in Figure 2 from segment SP-1294 to SP-1288. The cross-connection should be sloped from the 10-inch to the 8-inch to discourage flows from 8-inch from flowing into this sewer segment during dry weather operations.

Project 4 – As shown on the right hand side of Figure 3, the existing 18-inch sewer in Grant Avenue can not convey the increased flow from the Callahan Estates and Ogando Hudson developments without surcharging. The surcharged condition exists for the 18-inch sewer along Grant Avenue from Railroad Avenue to East Street and continues on East Street to the intersection of East Street and East Main Street where the 18-inch sewer gets steeper as it flows to the East Street Pump Station. In other words, the 18-inch sewer is surcharged for approximately 2,100 feet.

The surcharging of the 18-inch sewer can be eliminated by upsizing the 2,100 feet of impacted 18-inch sewer to 21-inch. One alternative to upsizing the existing 18-inch is to reroute some of the flows south of Grant Avenue to the East Street Pump Station via a new route. The flow reroute alternative, shown in Figure 3 as project number 4, is recommended instead of the upsizing option since rerouting flow would provide relief to the surcharging condition on the 18-inch, provide operational flexibility for the City, and is a less expensive alternative.[3] As shown in Figure 3, the recommended new alignment is 1,175 feet total and would run southeast on Railroad Avenue from East Abbey Street. At East Main Street, the new alignment would turn eastward and eventually merges with the existing 18-inch sewer on East Street before flowing to the pump station. Flows south of and on Abbey Street would be diverted via this new alignment.

[2] The outer diameter of a 10-inch nominal polyethylene pipe is 10.75 inches and the average inside diameter for pressure class DR 13.5 is 9.062 inches.

[3] It is estimated that the cost to upsize 2,100 feet of 18-inch to 21-inch sewer is $618,000. The estimated cost for the recommended alternative is $316,000. The assumptions used in estimating these costs are detailed in Section III.

III. Cost Estimates

The cost estimates for the recommended projects are shown in Table 1.

Table 1: Estimated Cost for Modifications to the Sewer Collection System

PROJECT & ITEM DESCRIPTION	QUANTITY	UNIT COST	TOTAL [a]
1. Enlarge Carter Ranch Pump Station			
a. Duplex 335 gpm pump station (one duty, one standby)	2 pumps + associated equipment	$50,000 [b]	$50,000
2. Upsize & Rehabilitate the Existing 8-inch Sewer on Grant Ave.			
a. Condition Assessment (CCTV)	7,050 ft	$1.50/ft [c]	$11,000
b. Pipe burst 8-inch to 10-inch	3,525 ft	$140/ft [d]	$494,000
3. Interconnect Sewers on Grant Ave. at Main St.			
a. 8-inch sewer line	50 ft	$130/ft [e]	$7,000
b. Manhole	1	$2,500/manhole [f]	$3,000
4. Construct Relief Sewer from Railroad/E. Abbey to Main St.			
a. 18-inch sewer line	1,175 ft	$260/ft [d]	$306,000
b. Manholes	4	$2,500/manhole [f]	$10,000
		CONSTRUCTION SUBTOTAL	**$881,000**
Construction Contingency		30%	$265,000
		CONSTRUCTION TOTAL	**$1,146,000**
Implementation [g]		30%	$344,000
		PROJECT TOTAL	**$1,490,000**

[a] Rounded up to the nearest $1,000. SFENR CCI 7997.
[b] Based on design projects in Sacramento County.
[c] Condition assessment for both 8-inch and 10-inch Grant Avenue sewer. Based on average CCTV cost for Sacramento County.
[d] Based on Sacramento Sewage Facilities Expansion Master Plan, $14/LF/in.
[e] Based on Sacramento Sewage Facilities Expansion Master Plan, $16/LF/in.
[f] Assumed pre-cast concrete. Based on estimate for Delta Diablo Sanitation District Bridgehead Improvement Project, Phase I (May 2003)
[g] Typical for planning level cost estimation. Contingency includes planning and engineering design, construction administration and management, environmental assessments and permits, administration costs, and legal fees.

Technical Memorandum 2B & 3B

Raines, Melton & Carella, Inc.

City of Winters – Sewer System Master Plan

Subject: Sewer System Modeling Results & Recommended System Improvements - FINAL

Prepared For: Michael Karoly, PE - City of Winters

Prepared By: Mai-Tram Le, P.E.

Reviewed By: Glenn E. Hermanson, P.E.

Date: August 2, 2004 (FINAL)
January 20, 2004 (DRAFT)

Reference: 098.0022

I. Introduction

This Technical Memorandum (TM) presents the sewer system modeling results and recommended system improvements for the City of Winters' (City) Sewer Master Plan. The modeling results, system analysis, and recommended system improvements presented in this TM will be used as a basis to develop a prioritized sewer system capital and maintenance program for the City.

This TM is organized as follows:

- I. Introduction
- II. Capacity Deficiency Criteria
- III. Sewer System Modeling Results
- IV. Conveyance Capacity Deficiencies
- V. Pump Station Evaluation & Recommendations
    - A. East Street Pump Station Forcemain Analysis
- VI. Proposed Sewer Collection System Improvements and Expansions
    - A. Existing Sewer Collection System Improvements
    - B. Future Sewer Collection System Expansions

II. Capacity Deficiency Criteria

Table 1 summarizes the criteria that were used to determine conveyance and pumping capacity deficiencies.

Table 1: Capacity Deficiency Criteria

	CAPACITY DEFICIENCY CRITERIA
Conveyance	A pipe is considered deficient if either or both of the following condition are met with design flows [a]: 1. There is potential for manhole overflow [b] 2. The ratio of the modeled design flow to the calculated pipe hydraulic capacity [c] exceeds 1.2 and there is more than 4 feet of surcharging [d]
Pumping	A pump station is considered deficient if its firm capacity [e] is less than calculated design flows [a]

a. As established in the *DRAFT Wastewater Design Flow Criteria TM 1B2*, City of Winters – Sewer System Master Plan, November 10, 2003.
b. It is assumed that there is potential for manhole overflow if the hydraulic gradeline is less than 3 ft. below the ground surface. This definition accounts for potential error in rim elevation data and model accuracy. This criterion is of primary importance: a manhole overflow could represent public health risk, carries significant fines imposed by the Regional Water Quality Control Board, and could result in increase regulatory scrutiny through the pending EPA's CMOM regulations.
c. The hydraulic capacity is calculated based on the physical characteristics of the pipe and does not account for reduced capacity due to root intrusion, excessive grease accumulation, or debris. The City is responsible to ensure that 100% of the pipe capacity is available for wastewater flow.
d. Criterion allows the existing system to operate under surcharge conditions for short period of time during peak wet weather flow.
e. Firm capacity is the capacity of the pump station with the largest pump not operating.

III. Sewer System Modeling Results

A hydraulic model was developed as part of this Sewer System Master Plan using H2OMap Sewer Version 5.0 model. The model of the collection system included all sewers 10-inches and larger, key 8-inch sewers, and, in the downtown area, key 6-inch sewers. Load allocation for the existing collection system is shown in Figure A1 in Attachment A. The H2OMap Sewer hydraulic model was run under the existing and buildout design flow conditions.[1] Potential conveyance capacity deficiencies under each scenario were then identified based on criteria established in Table 1.

Figures A2 to A5 in Attachment A show the modeling results under the existing and buildout average dry (ADWF) and peak wet weather flow (PWWF) conditions for the existing collection system. As shown in Figure A2, the City's existing sewer conveyance system does not have any deficiencies (i.e. surcharge or potential overflows) under existing (as of September 2002) average dry weather conditions. Under existing peak wet weather (i.e. design flow conditions), Figure A3 shows that the system has 7 surcharged sewers, 7 undersized sewers, and 2 potential overflow manholes. For the purpose of this TM, surcharged sewers are pipes where the ratio of the modeled design flow to the calculated pipe hydraulic capacity (q/Q) exceeds 1.0 but is less than 1.2 and undersized sewers are pipes where the q/Q ratio exceeds 1.2.

Figures A4 and A5 presents the hydraulic modeling results for the existing conveyance system under buildout flow conditions and is included for references only to emphasize the point that the City will definitely need to construct more sewer infrastructure in order to convey the additional sewer generated as development occurs. The existing conveyance system was evaluated in depth to identify potential capital improvement projects after a proposed citywide layout of future sewers and pump stations was incorporated into the model.

[1] As established in the *DRAFT Wastewater Design Flow Criteria TM 1B2*, City of Winters – Sewer System Master Plan, November 10, 2003

IV. Conveyance Capacity Deficiencies

Based on inputs from the City, the Drainage Master Plans and the proposed Winters Highlands and Callahan Estates developments, a proposed citywide layout of future sewers and pump stations were added to the City's existing conveyance system for analysis of future land use scenarios. The proposed citywide layout of future sewers and pump stations is shown in Figure 1. Load allocations for the future sewer collection system are shown in Figure A6 in Attachment A.

Figure 1 shows six potential deficiency locations for the existing sewer collection system under the PWWF design condition at buildout. These locations showed a potential deficiency even after the incorporation and rerouting of future developments to proposed future sewers in the collection system.

The hydraulic profiles for the six identified deficiency locations are presented in Attachment B. Table 2 summarizes the deficiencies and pipe characteristics for each location. The deficiencies, pipe characteristics, recommendation for improvements, and potential for cost sharing are further discussed for each location below. Additional information on the recommended projects are presented in Section VI.A of this TM while detailed cost and will be presented in the 2004 Sewer Master Plan Report.

Location a – The sewer of interest for this location on First Street consists of one 6-inch sewer segment (SP-1132) that is approximately 134% over capacity. This deficiency could be resolved by upsizing this 155 foot segment to an 8-inch sewer to match the downstream sewers. However, since this pipe is relatively deep (at 9 feet) with a low risk of causing an overflow and the surcharging is localized; it is recommended that the City does not pursue this project.

Location b – As shown in the profile for location b in Attachment B, pipe SP-1290 is a flat 10-inch sewer on Grant Avenue. The slope for this sewer could not be verified through existing records and survey data. Hence, it is recommended that the City investigate/survey sewer slopes for this area and perform further analysis before pursuing any project.

Location c – This location has three 18-inch sewers (SP-1182, SP-1180, and SP-1178) that currently convey flows, including the 155 gpm flows from El Rio Villa, to the East Street Pump Station. Under the buildout PWWF scenario, El Rio Villa flows are diverted north to Future Pump Station C (as shown in Figure 1). Even with the El Rio Villa flow being diverted north, location c still shows a potential deficiency under the buildout PWWF scenario.

The profile for these 18-inch sewers showed that they are relatively deep (at 12 feet) with a low risk of causing an overflow since the calculated hydraulic grade line (HGL) is approximately 11 feet below the ground surface. In addition, the surcharging is localized. Therefore, it is recommended that the City does not pursue any project for this location.

Location d – This location consists of three 6-inch sewers (SP-1048, SP-1078, and SP-1080) along Edwards Street that has the potential to be approximately 125% over capacity if flows from the undeveloped Creekside Estates development are routed to the Edwards Street sewers once it is developed. These potential deficiencies could be resolved by upsizing the Edwards Street sewers to 8-inch.

Since the Creekside Estates parcels are currently undeveloped, it is recommended that the City does not pursue this project at this time. Instead, it is recommended that a detailed study to evaluate the sewer capacity available in the Edward Street sewers be conducted prior to the development of the Creekside Estates parcels. The study should confirm that flows from Waggoner Elementary School are not discharged to Edwards Street, confirm existing and buildout flows from Waggoner Elementary School, and evaluate options for routing flows from the Creekside Estates.[2]

Location 1 – The deficiency for Location 1 consists of a series of nine 8-inch and three 6-inch sewer, starting on Railroad Avenue and continuing on to Anderson Avenue and Hemenway Street, which are undersized. The undersized sewers caused a long bottleneck with potential sewer overflow reaching as far back as Neimann Street as a result.[3] Due to the high risk of having potential wet weather overflows, it is recommended that the City pursue projects to upsize these sewer segments.

Deficiencies for Location 1 exist even without any additional flows from future developments. For this reason, existing ratepayers should financially anticipate in at least up-sizing the 8-inch sewer on Railroad Avenue.

The configuration of the sewer on Hemenway Street between Anderson and Grant Avenues indicates that it would act as an overflow relief sewer during surcharge conditions. The computer software (H_2OMap Sewer) does not have the level of sophistication necessary to model this overflow relief. Therefore, additional analysis should be performed before implementing this project. In addition to additional analysis, the manhole on Hemenway Street should be uncovered (they are currently paved over).

Location 2- The deficiency for Location 2 consists of a series of four sewers on East Main Street immediately east of East Street to Morgan Street. A 6-inch sewer segment (SP-1286) coupled with three undersized sewers immediately upstream causes a long bottleneck with potential sewer overflow to reach as far back as East Baker Street and Grant Avenue. Due to the high risk of having potential wet weather overflows, it is recommended that the City pursue projects to upsize these four sewer segments

The severe bottleneck in the 6-inch sewer exists under existing peak wet weather conditions as shown in Figure A3 in Attachment A. Hence, existing ratepayers should financially participate in upsizing this sewer.

Under buildout PWWF, with additional flows from the Gateway area, deficiencies for Location 2 expanded to include three 10—inch sewers (SP-1284, SP-1282, and SP-1280) immediately upstream of the 6-inch sewer. Since the deficiencies for these three sewers were triggered as a result of additional flows from developments in the Gateway Area, future developers in this area should anticipate financially participating in upsizing these segments.

[2] As directed by the City, flows from Waggoner Elementary School are currently loaded to the Grant Avenue sewers for a conservative analysis of the existing capacity along Grant Avenue.

[3] Analysis with the "Creekside Estates" and "Cottages" parcels loaded to the Grant Avenue sewers resulted in less severe deficiencies for Location 1.

Figure 1: Modeling Results for Proposed Future Sewer System at Buildout Peak Demands

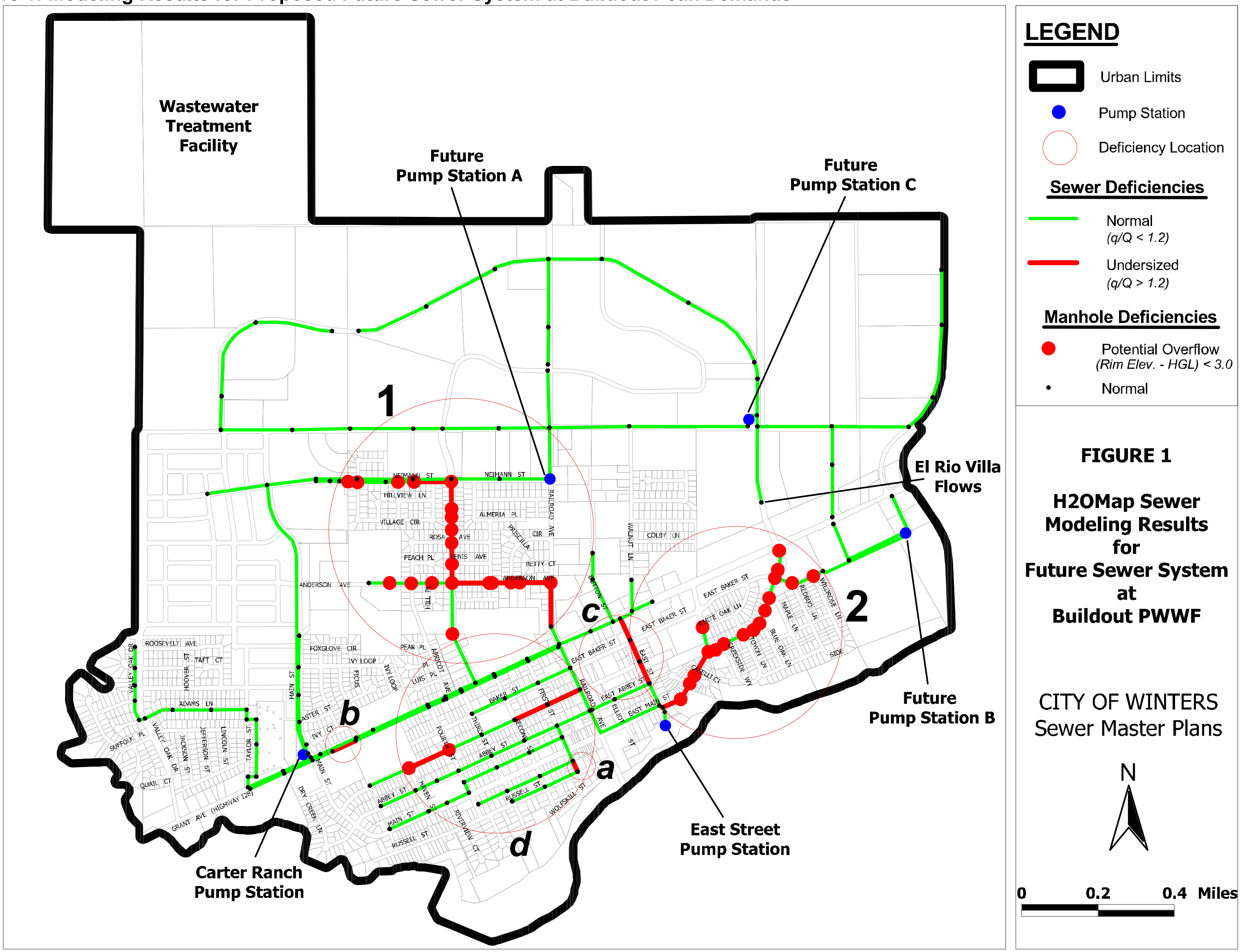


Table 2: Potential Wet Weather Conveyance Capacity Deficiencies [a]

PIPE ID [b]	STREET	DIAMETER (in.)	LENGTH (ft.)	DEPTH (ft.)	CAPACITY DEFICIENCIES (q/Q) [c]
LOCATION a					
SP-1132	First Street northwest of Russell Street	6	155	9	1.342
LOCATION b					
SP-1290	Grant Avenue northeast of Main Street	10	330	8	1.309
LOCATION c					
SP-1178	East Street northwest of East Abbey St.	18	315	13	1.281
SP-1180	East Street northwest of East Edward St.	18	310	12	1.504
SP-1182	East Street southeast of Grant Avenue	18	310	12	1.237
LOCATION d					
SP-1080	Edwards Street west of Railroad Avenue	6	465	10	1.310
SP-1078	Edwards Street west of First Street	6	470	7	1.236
SP-1048	Edwards Street west of Fourth Street	6	570	5	1.201
LOCATION 1					
SP-2292	Railroad Avenue south of Anderson Ave.	8	575	11	2.289
SP-1009	Anderson Avenue west of Railroad Ave.	8	405	10	2.318
SP-2284	Anderson Avenue west of Railroad Ave.	8	110	10	1.880
SP-2276	Anderson Avenue west of Railroad Ave.	8	285	9	1.792
SP-2274	Anderson Avenue west of Railroad Ave.	8	20	9	1.816
SP-2242	Anderson Avenue east of Hemenway St.	8	480	10	1.752
SP-2240	Hemenway Street north of Anderson Ave.	8	245	10	1.448
SP-2238	Hemenway Street south of Rosa Ave.	8	275	9	1.555
SP-2228	Hemenway Street north of Rosa Ave.	8	170	9	1.412
SP-2208	Hemenway Street south of Neimann St.	6	110	7	2.022
SP-2206	Hemenway Street south of Neimann St.	6	350	7	1.781
SP-2204	Neimann Street west of Hemenway St.	6	485	8	2.089
LOCATION 2					
SP-1286	East Main Street east of East Street	6	260	17	5.605
SP-1284	East Main Street east of East Street	10	240	17	1.396
SP-1282	East Main Street east of Lauren Court	10	125	15	1.379
SP-1280	East Main Street east of Caselli Court	10	340	14	1.349

[a] Based on H_2OMap Sewer hydraulic model runs under the existing and buildout design flow conditions
[b] Refers to H_2OMap Sewer numbering system
[c] Expressed as ratio of the modeled design flow to the calculated pipe hydraulic capacity

V. Pump Station Evaluation & Recommendation

The City currently operates and maintains four pump stations: 1) Walnut Lane, 2) El Rio Villa, 3) Carter Ranch, and 4) East Street. For the purpose of this master plan, it was assumed that flows at the Walnut Lane and El Rio Villa Pump Stations are at buildout and, hence, the capacity of these pumps stations is adequate for future conditions.

Hydraulic analysis showed that at buildout, the City will need three more pump stations in order to convey all flows generated throughout the City to the existing wastewater treatment facility at the northwest corner of the urban limits boundary. The proposed locations of these three new pump stations (i.e. Future Pump Station A, Future Pump Station B, and Future Pump Station C) are shown in Figure 2. Future Pump Station C (Project no. 11 in Figure 8) has 2 conveyance alternatives that affect the sizing of Future Pump Station A. The firm capacity of these pump stations are as follows:

1. Future Pump Station A = 3,800 gpm/5.5 mgd ***(under Alternative 1 of Project 11)***
   = 1,950 gpm/2.8 mgd ***(under Alternative 2 of Project 11)***
2. Future Pump Station B = 310 gpm/0.45 mgd
3. Future Pump Station C = 1,850 gpm/2.7 mgd

In addition to the three new pump stations, analysis showed that the Carter Ranch and East Street Pump Stations will also have to be expanded to convey all the flows generated at buildout peak wet weather conditions.

The Carter Ranch Pump Station (PS) was designed to convey flows from the Carter Ranch subdivision to Grant Avenue until the land and infrastructure north of Carter Ranch (i.e. Winters Highlands and Callahan Estates) is developed and allows the sewage to flow north. Since the Carter Ranch PS was designed to solely convey flows generated by the Carter Ranch subdivision, the capacity of this duplex pump station is 125 gpm (i.e. 0.18 mgd). Land use analysis, load allocation, and hydraulic modeling showed that at buildout, with the addition of flows from the Callahan and Winters Highlands subdivisions, the Carter Ranch PS will need to be expanded to approximately 400 gpm (i.e. 0.58 mgd) in order to convey all the flows coming into the pump station northward to Neimann Street.

The East Street PS is currently the main pump station for the City. All sewers currently drain to this pump station before being lifted and conveyed approximately 2.7 miles to the wastewater treatment facility via the 14-inch East Street PS forcemain. This pump station has three pumps, two at 88 hp and one at 47 hp. Hence, the existing firm capacity of this pump station, with one of the 88 hp pump being out of service, is 2,600 gpm (3.75 mgd). Under buildout conditions, flow from the Carter Ranch and El Rio Villa Pump Stations will cease to enter this pump station. However, even without the flow from Carter Ranch and El Rio Villa, the East Street PS will still need to be expanded to convey 3,300 gpm (4.75 mgd) at buildout during PWWF events.

As the flows to the East Street PS and pressures within the East Street Force Main increase, it will become critical to upgrade portions of the pump station instrumentation. In particular, the flow data and pressure data should be recorded and stored electronically and alarm systems for the pump station functions (e.g. high water, pump failure, etc.) should be upgraded. Collecting this data will allow pump station and forcemain performance evaluations to be completed, which will allow timing of larger projects (e.g. parallel force main) to be determined.

A. East Street Pump Station Forcemain Analysis

The existing East Street PS forcemain is a 14-inch asbestos cement pipe. The pressure class of this cement pipe is unknown at this time. At the design flowrate of 4.75 mgd, the operating pressure would be 143 psi. This operating pressure may be greater than the pressure class rating this pipe. Therefore, it is recommended that a 14-inch parallel forcemain be constructed in the future. This parallel forcemain would also allow the existing forcemain to be taken out of service during dry weather for condition assessment and maintenance.

VI. Proposed Sewer Collection System Improvements and Expansions

Proposed sewer collection system improvements and expansions were developed based on the design criteria presented in TM 1B of the Sewer Master Plan.[4] These projects are shown in Figure 2 and listed in Tables 3 and 4.

A. Existing Sewer Collection System Improvements

Two projects listed in Table 3 are recommended to improve the existing sewer collection system in order to avoid potential sewer over flow under the buildout peak wet weather scenario. In general, replacement pipes were preferred over parallel pipes because: 1) the difference in the parallel and replacement pipe was generally only one or two diameters; 2) long-term maintenance is more efficient with fewer pipes and manholes in the system; and 3) underground utility congestion is minimized with fewer pipes.

Table 3: Proposed Improvement Projects [a]

PIPE ID [b]	STREET	EXISTING DIAMETER (in.)	LENGTH (ft.)	CAPACITY DEFICIENCIES (q/Q) [c]	RECOMMENDED RELIEF DIAMETER (in.)
PROJECT 1 – Anderson Avenue Sewer Upsize					
SP-2292	Railroad Ave. south of Anderson Ave.	8	575	2.289	**12**
SP-1009	Anderson Ave. west of Railroad Ave.	8	405	2.318	**10**
SP-2284	Anderson Ave. west of SP-1009	8	110	1.880	**10**
SP-2276	Anderson Ave. west of SP-2284	8	285	1.792	**10**
SP-2274	Anderson Ave. west of SP-2276	8	20	1.816	**10**
SP-2242	Anderson Ave. east of Hemenway St	8	480	1.752	**10**
SP-2240	Hemenway St. north of Anderson Ave.	8	245	1.448	**10**
SP-2238	Hemenway Street south of Rosa Ave.	8	275	1.555	**10**
SP-2228	Hemenway Street north of Rosa Ave.	8	170	1.412	**10**
SP-2208	Hemenway St. south of Neimann St.	6	110	2.022	**8**
SP-2206	Hemenway St. south of Neimann St.	6	350	1.781	**8**
SP-2204	Neimann Street west of Hemenway St.	6	485	2.089	**8**
PROJECT 2 – East Main Street Sewer Upsize					
SP-1286	East Main St east of East St	6	260	5.605	**12**
SP-1284	East Main St east of SP-1286	10	240	1.396	**12**
SP-1282	East Main St east of Lauren Ct	10	125	1.379	**12**
SP-1280	East Main St east of Caselli Ct	10	340	1.349	**12**

[a] Based on H_2OMap Sewer hydraulic model runs under buildout design flow conditions
[b] Refers to H_2OMap Sewer numbering system
[c] FIRM capacity is the capacity with the largest pump not operating.
[d] Expressed as ratio of the modeled design flow to the calculated pipe hydraulic capacity

[4] *TM 1B - Sewer Collection Design Criteria for Master Planning, RMC, October 2003.*

B. Future Sewer Collection System Expansions

The proposed future sewer collection system expansion layout on Figure 2 was developed based on inputs from the City, the Drainage Master Plans, the proposed Winters Highlands and Callahan Estates developments, and hydraulic modeling of the buildout peak wet weather scenario. In all, there are twenty sewer and pump station expansion projects listed in Table 4 and shown in Figure 2.

Table 4: Proposed Expansion Projects [a]

PIPE ID [b]	DESCRIPTION	PROPOSED DIAMETER (in.)	LENGTH (ft.)	PROPOSED PUMP STATION FIRM CAPACITY [c]
PROJECT 3 – Carter Ranch Pump Station Expansion				
---	*Carter Ranch Pump Station Expansion [d]*	---	---	*400 gpm/0.68 mgd*
PROJECT 4 – Carter Ranch Force Main				
SP-2158	Carter Ranch Pump Station Forcemain	10	4,000	---
PROJECT 5 – Pump Station on Railroad Avenue				
---	*Future Pump Station A*	---	---	*3,800 gpm/5.5 mgd*
PROJECT 6 – Neimann Street Sewers				
SP-30041	Neimann Street east of Main Street	15	1,100	*Note: The Neimann Street Sewers Project is parallel to the existing sewers in Neimann Street*
SP-30111	Neimann Street east of SP-30041	15	540	
SP-30113	Neimann Street east of Village Circle	15	720	
SP-30115	Neimann Street west of Hemenway Street	15	500	
SP-30021	Neimann Street east of Hemenway Street	15	630	
SP-30023	Neimann Street west of Railroad Avenue	15	650	
PROJECT 7 – Neimann Street/Winters Highlands Sewers				
SP-30039	Neimann Street west of Main Street	12	800	---
PROJECT 8 – Pump Station for Gateway Area				
---	*Future Pump Station B*	---	---	*310 gpm/0.45 mgd*
PROJECT 9 – Pump Station B Forcemain				
SP-30015	Gateway Area Pump Station Forcemain	8	360	---
PROJECT 10 – Gateway Area Sewers				
SP-30001	South of Grant Avenue & Timbercrest Road	8	510	---
SP-30003	South of Grant Avenue & County Road 90	8	510	
SP-30007	West of Pump Station B	8	840	
PROJECT 11 – Pump Station for the Northeastern Area				
---	*Future Pump Station C*	---	---	*1,850 gpm/2.7 mgd*
	Option 1 – Gravity Flow to Pump Station A	---	---	***See Project 16***
	Option 2 – Forcemain to the Parallel East Street Pump Station Forcemain	14	2,750	---

PIPE ID [b]	DESCRIPTION	PROPOSED DIAMETER (in.)	LENGTH (ft.)	PROPOSED PUMP STATION FIRM CAPACITY [c]
PROJECT 12 – Northeastern Area Sewers				
SP-30087	Northmost Sewer on County Road 90	8	710	---
SP-30089	County Road 90 south of SP-30087	10	950	
SP-30091	County Road 90 south of SP-30089	10	500	
SP-30093	Moody Slough Road west of County Road 90	10	990	
SP-30085	Moody Slough Road west of SP-30093	15	950	
SP-30077	North Main Street north of Moody Slough Rd.	15	140	
SP-30109	North Main Street to Future Pump Station C	18	110	
PROJECT 13 – Timbercrest Road Sewers				
SP-30105	Timbercrest Road north of Grant Avenue	8	680	---
SP-30083	Timbercrest Road north of SP-30105	8	520	
PROJECT 14 – North Main Street Sewers				
SP-30081	North Main Street south of Moody Slough	8	980	---
---	Reroute El Rio Villa Forcemain	6	600	
PROJECT 15 – Main Street Loop Sewers				
SP-30053	Westernmost Sewer on Loop for Project 15	8	1,100	---
SP-30055	Main Street Loop east of SP-30053	8	1,020	
SP-30057	Main Street Loop west of Railroad Avenue	8	720	
SP-30059	Railroad Avenue south of Main Street Loop	8	880	
SP-30061	Railroad Avenue south of SP-30059	8	480	
SP-30067	Main Street Loop east of Railroad Avenue	10	690	
SP-30069	Main Street Loop east of SP-30067	12	1,260	
SP-30071	Main Street Loop southeast of SP-30069	12	1,190	
SP-30099	Main Street Loop south of SP-30071	12	220	
SP-30101	Main Street Loop south of SP-30099	12	480	
PROJECT 16 – Moody Slough Sewers				
SP-30049	Main Street Loop west of SP-30053	8	510	---
SP-30051	Main Street Loop south of SP-30049	10	690	
SP-30027	Main Street Loop south of SP-30051	10	440	
SP-30029	Moody Slough Road east of Main Street	12	920	
SP-30097	Moody Slough Road east of SP-30029	12	570	
SP-30031	Moody Slough Road east of SP-30097	12	820	
SP-30033	Moody Slough Road east of SP-30031	12	380	
SP-30035	Moody Slough Road east of SP-30033	12	730	
SP-30037	Moody Slough Rd. west of Railroad Avenue	12	650	
SP-30025	Railroad Avenue south of Moody Slough Rd.	24	660	
SP-30063	Railroad Avenue north of Moody Slough Rd.	8	740	
SP-30103	Moody Slough Road east of SP-30079	18	1,530	***Project 11 (Option 1)***
SP-30079	Moody Slough Road east of Railroad Ave.	18	1,030	
SP-30103	Moody Slough Road east of SP-30079	8	1,530	***Project 11 (Option 2)***
SP-30079	Moody Slough Road east of Railroad Ave.	8	1,030	

PIPE ID [b]	DESCRIPTION	PROPOSED DIAMETER (in.)	LENGTH (ft.)	PROPOSED PUMP STATION FIRM CAPACITY [c]
PROJECT 17 – East Street Pump Station Expansion				
---	*East Street Pump Station Expansion* [e]	---	---	*3,300 gpm/4.75 mgd*
	East Street Pump Station Instrumentation	---	---	---
PROJECT 18 – Parallel East St. PS Forcemain 1 (from Pump Station A to Treatment Plant)				
---	Parallel Forcemain Segment #1	14	9,000	---
PROJECT 19 – Parallel East St. PS Forcemain 2 (from East St. PS to Pump Station A)				
---	Parallel Forcemain Segment #2	14	5,000	---
PROJECT 20 – Relief Sewer from Railroad/East Abbey to Main Street				
SP-30119	Railroad Ave. and East Main Street	18	1,175	---
PROJECT 21 – Upsize & Rehabilitate the Existing 8-inch Sewer on Grant Avenue				
SP-1324	Grant Avenue east of Main Street	10	610	---
SP-1326	Grant Avenue east of Main Street	10	240	
SP-1328	Grant Avenue east of Main Street	10	780	
SP-1330	Grant Avenue east of Fourth Street	10	255	
SP-1334	Grant Avenue west of Third Street	10	220	
SP-1336	Grant Avenue east of Third Street	10	210	
SP-1338	Grant Avenue east of Hemenway Street	10	275	
SP-1340	Grant Avenue east of Second Street	10	475	
SP-1342	Grant Avenue west of Railroad Avenue	10	460	
PROJECT 22 – Interconnect Sewers on Grant Avenue at Main Street				
---	Grant Avenue at Main Street	8	50	---

[a] Based on H_2OMap Sewer hydraulic model runs under buildout design flow conditions
[b] Refers to H_2OMap Sewer numbering system
[c] Firn capacity is the capacity of the pump station with the largest pump not operating
[d] The existing capacity of the Carter Ranch Pump Station is 125 gpm
[e] The existing capacity of the East Street Pump Station is 2,600 gpm

The proposed future expansion includes the rerouting of flows from El Rio Villa to Future Pump Station C. The re-routing project should be combined with project no. 14.

Projects 20, 21, and 22 will convey interim flows from Winters Highland, Callahan Estates, and Ogando Hudson developments to the East Street PS until additional developments (i.e. any development north of Moody Slough Road) necessitate the construction of Future Pump Station A (Project 5). At this point, it will be necessary to expand the Carter Ranch PS (Project 3) and construct the Carter Ranch forcemain from the PS to Neimann Street (Project 4). Depending on the timing of developments (e.g. Gateway Area), the East Street PS might need to be expanded (Project 17) to accommodate additional flows prior to the construction of Future Pump Station A.[5]

For project no. 11 (i.e. Future Pump Station C), there are two alternatives for conveying flows from this pump station to the wastewater treatment facility: 1) gravity flow to Future Pump Station A, and 2) forcemain conveyance directly to the wastewater treatment facility. Table 5 provides a comparison of project components between the two alternatives. Alternative 1 includes draining the flows from Future

[5] Additional discussions on routing options for flows from the Callahan Estates, Ogando Hudson developments, and Carter Ranch PS are presented in the *Hydraulic Evaluation for Proposed Ogando Hudson & Callahan Estates Developments TM* and the *Evaluation of Routing Options for the Carter Ranch Pump Station TM*

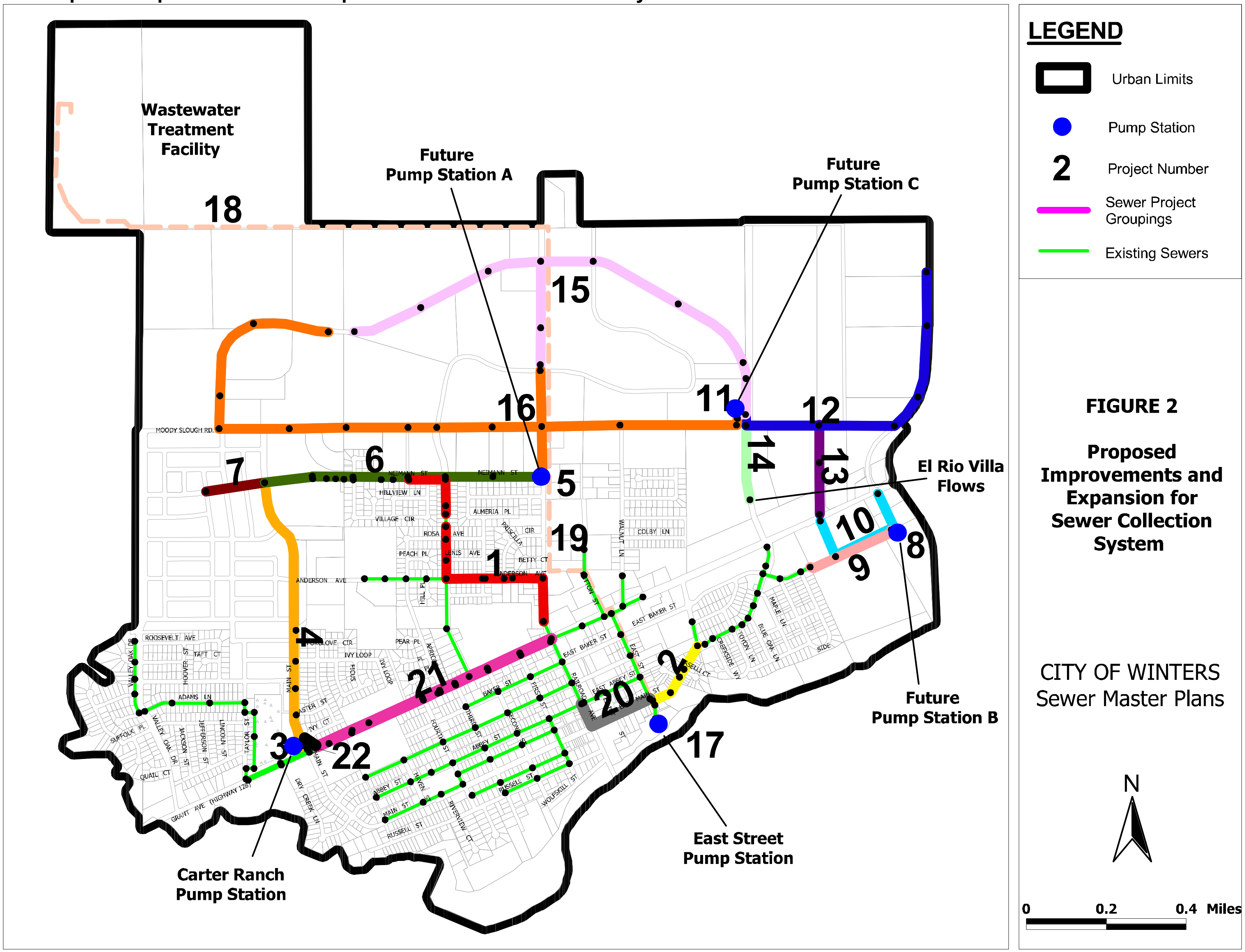
Pump Station C into Future Pump Station A on Railroad Avenue via the gravity sewer on Moody Slough Road. Under Alternative 1, sewage entering Future Pump Station C would be pumped twice and have a longer detention time in the system, possibly leading to odorous and corrosive environment. Furthermore, an 18-inch sewer segment on Moody Slough Road would mean that laterals for parcels fronting the road would have to connect to a manhole or would require a short collector sewer since they could not connect directly into the 18-inch main.

Under Alternative 2, sewage entering Future Pump Station C would be pump directly to the East Street Pump Station forcemain or a parallel forcemain to the East Street forcemain on Railroad Avenue and be conveyed directly to the wastewater treatment facility. The additional cost to construct the 2,600 feet forcemain could be offset by having a smaller Future Pump Station A and a reduction in sewer size on Moody Slough Road and Railroad Avenue. Furthermore, parcels fronting Moody Slough Road could connect directly to the 8-inch line. Therefore, Alternative 2 is recommended for Project No. 11.

Table 5: Conveyance Alternative Comparison for Project No. 11 (Future Pump Station C)

ALTERNATIVE	MOODY SLOUGH RD.	RAILROAD AVE.	FORCEMAIN	FUTURE PUMP STATION A
1 – Gravity Flow to Future Pump Station A	2,600 feet of 18 in. sewers	700 feet of 24 in. sewers	2,600 feet	3,800 gpm (5.5 mgd)
2 – Forcemain to Wastewater Treatment Facility	2,600 feet of 8 in. sewers	700 feet of 15 in. sewers	150 feet	1,950 gpm (2.8 mgd)

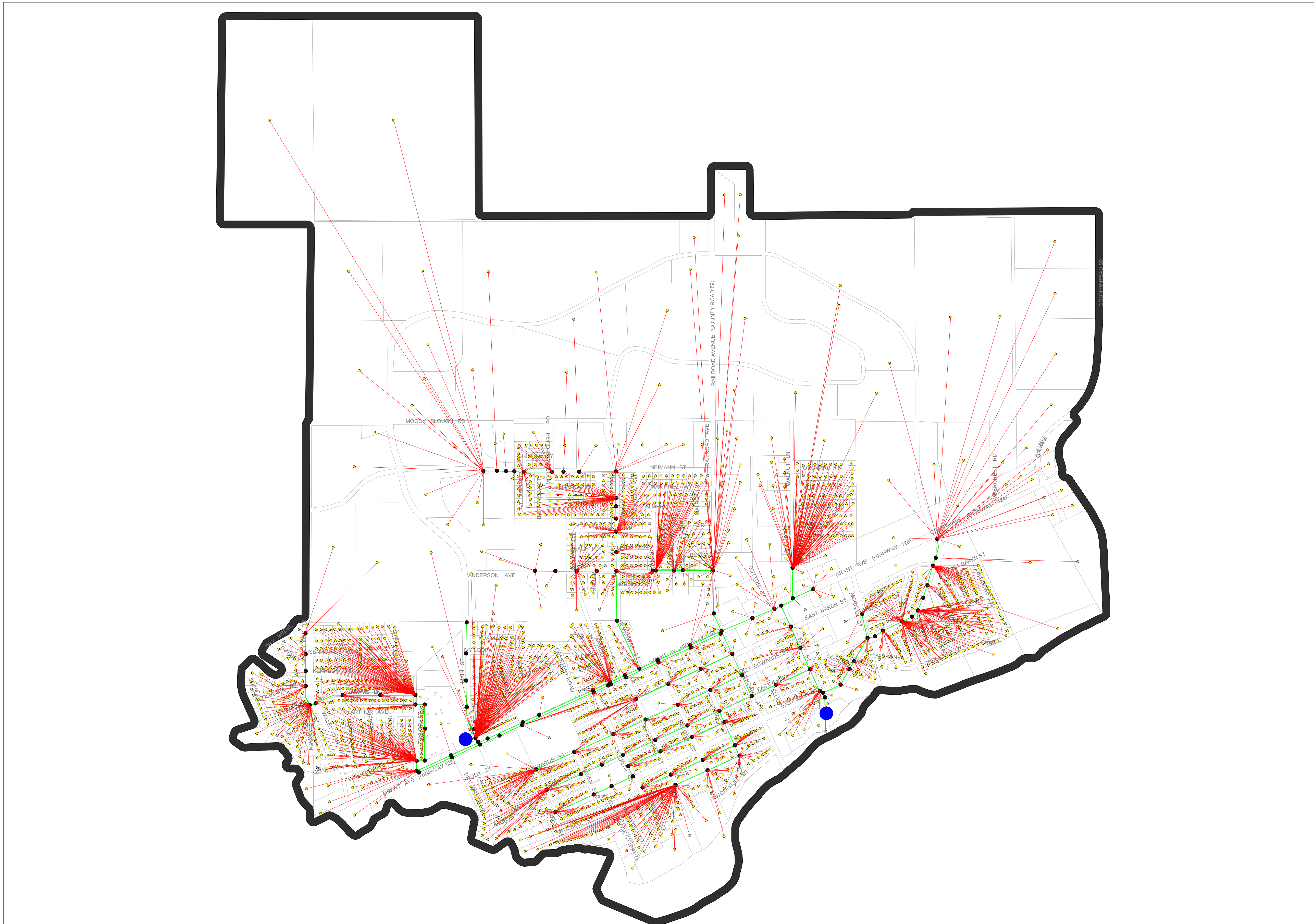
Figure 2: Proposed Improvements and Expansion for Sewer Collection System



ATTACHMENT A

TM Graphics

FIGURE A1: Load Allocation for Existing Sewer Collection System



LEGEND

- Urban Limits
- Pump Station
- Modeled Manholes
- Modeled Sewers
- Parcel Loading Point

FIGURE A1

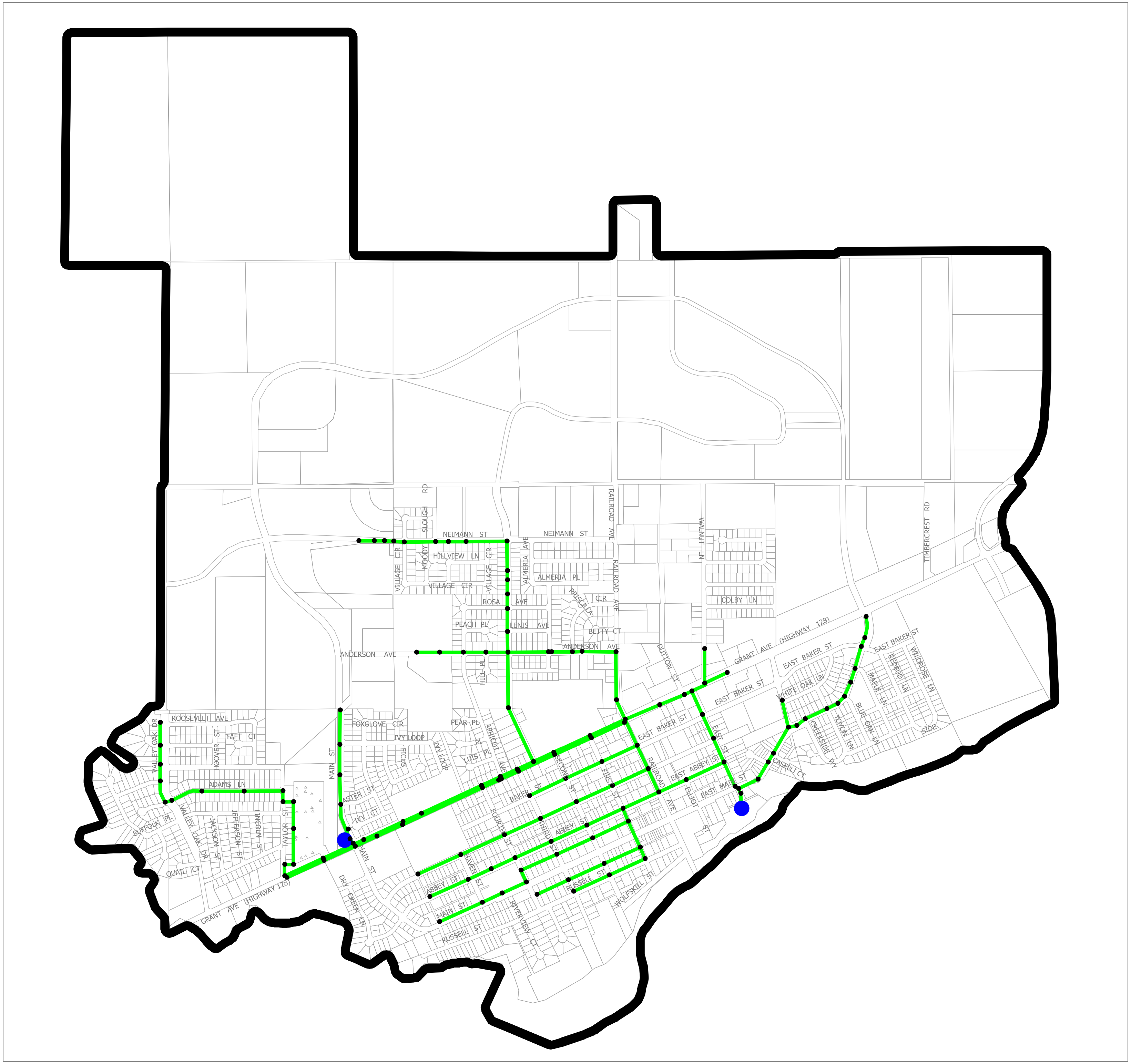
Load Allocation for Existing Sewer Collection System

CITY OF WINTERS
Sewer Master Plan

N

Prepared By: mtl

2004/08



LEGEND

Urban Limits

Pump Station

Sewer Deficiencies

Normal
(q/Q < 1.0)

Surcharged
(1.0 < q/Q < 1.2)

Undersized
(q/Q > 1.2)

Manhole Deficiencies

Potential Overflow
(Rim Elev. - HGL) < 3.0

Normal

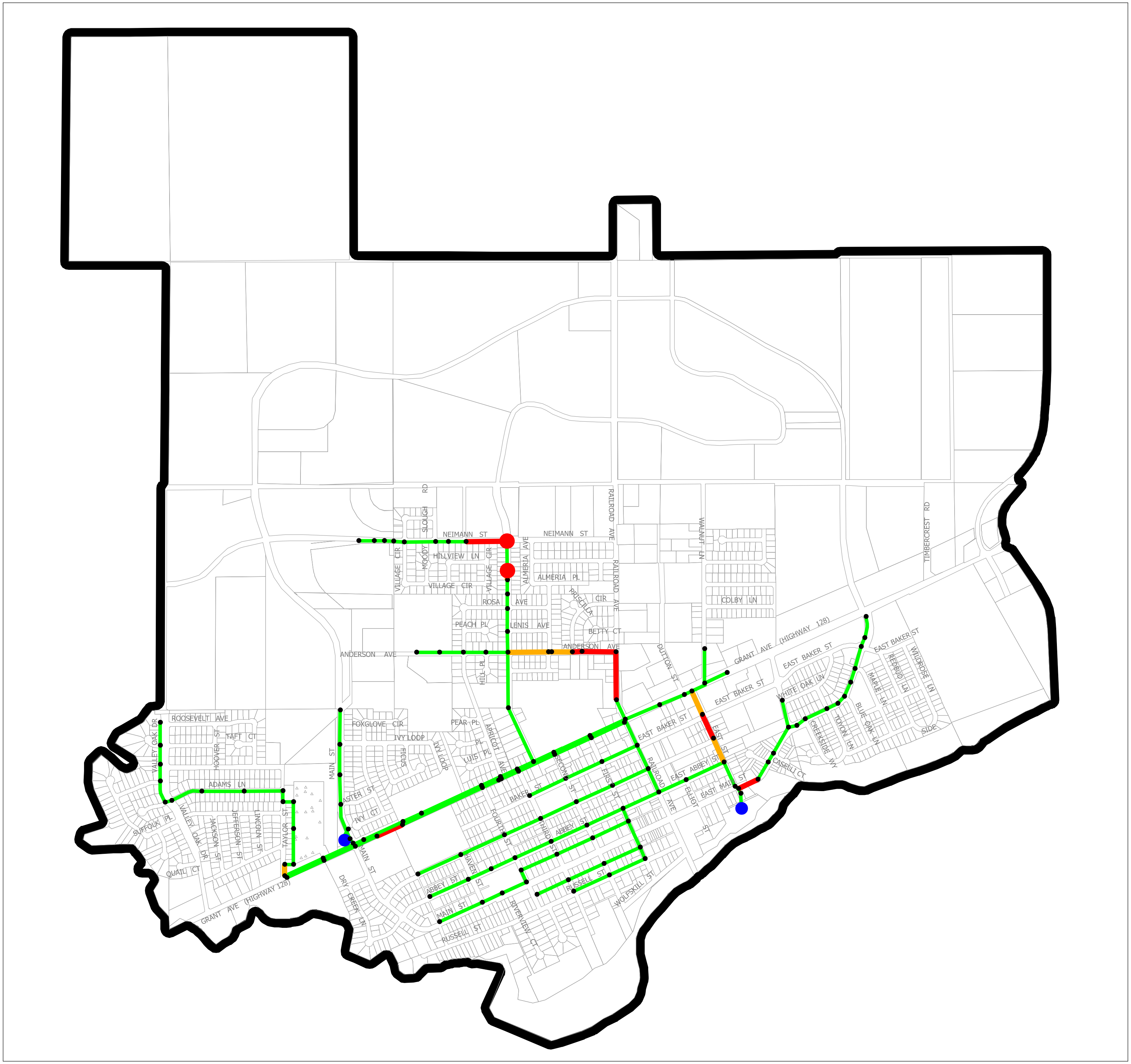
FIGURE A2

H2OMap Sewer Modeling Results for Existing ADWF (as of Sept. 2002)

CITY OF WINTERS
Sewer Master Plan

N

0 0.2 0.4 Miles



LEGEND

Urban Limits

Pump Station

Sewer Deficiencies

Normal
(q/Q < 1.0)

Surcharged
(1.0 < q/Q < 1.2)

Undersized
(q/Q > 1.2)

Manhole Deficiencies

Potential Overflow
(Rim Elev. - HGL) < 3.0

Normal

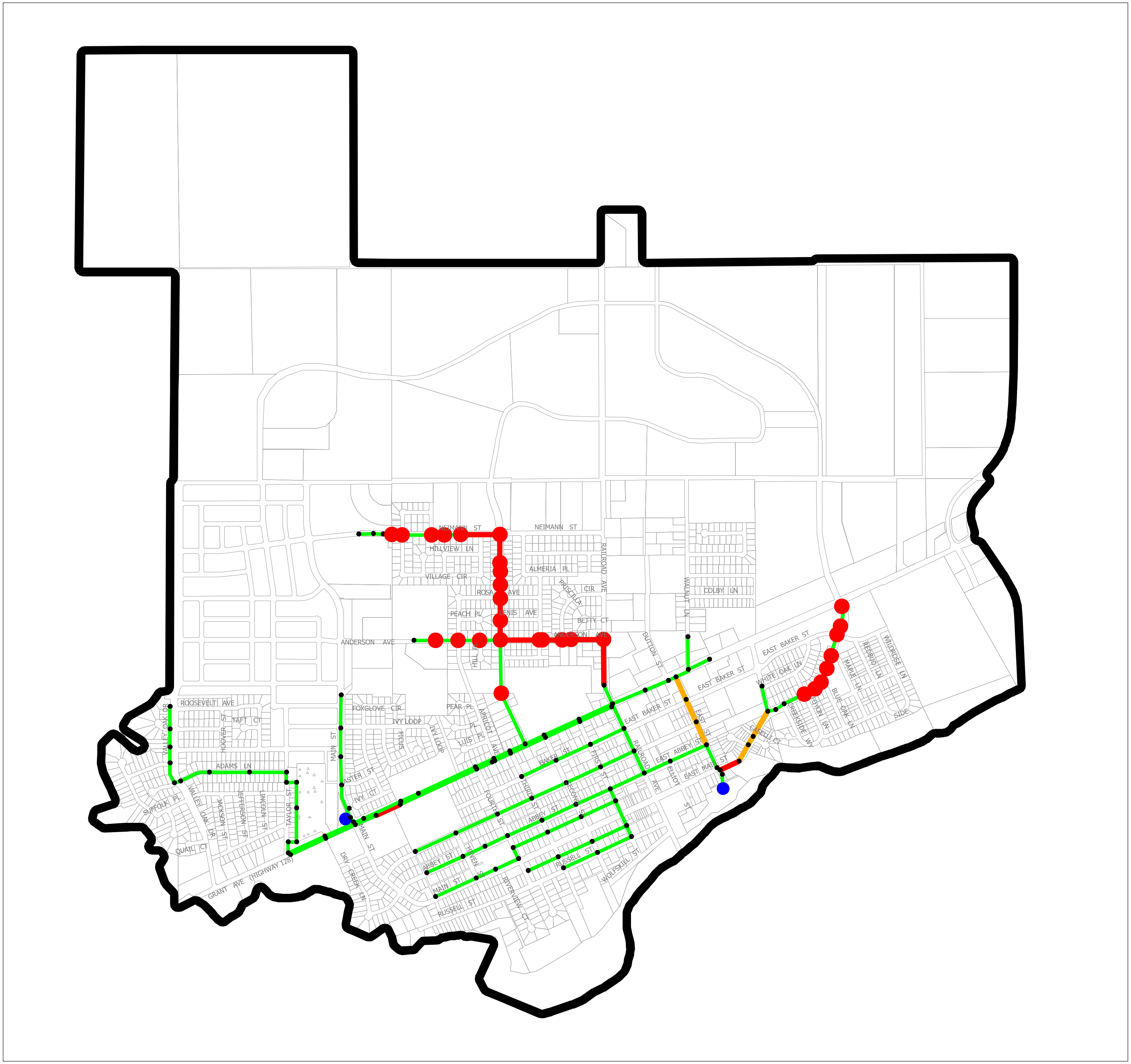
FIGURE A3

H2OMap Sewer Modeling Results for Existing PWWF (as of Sept. 2002)

CITY OF WINTERS
Sewer Master Plan

N

0 0.2 0.4 Miles



LEGEND

Urban Limits

Pump Station

Sewer Deficiencies

Normal
(q/Q < 1.0)

Surcharged
(1.0 < q/Q < 1.2)

Undersized
(q/Q > 1.2)

Manhole Deficiencies

Potential Overflow
(Rim Elev. - HGL) < 3.0

Normal

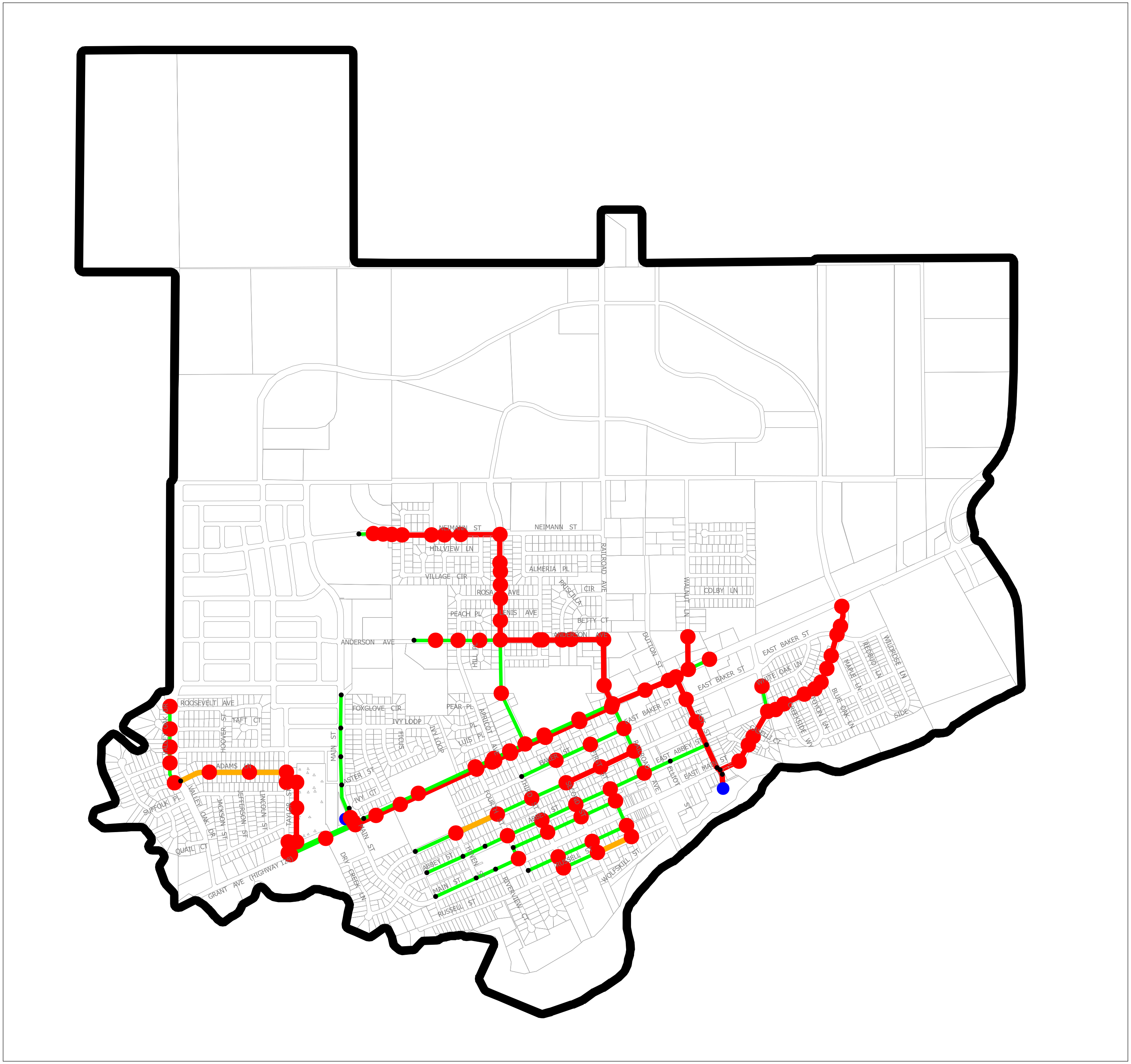
FIGURE A4

H2OMap Sewer Modeling Results for Buildout ADWF

CITY OF WINTERS
Sewer Master Plan

N

0 0.2 0.4 Miles



LEGEND

Urban Limits

Pump Station

Sewer Deficiencies

Normal
(q/Q < 1.0)

Surcharged
(1.0 < q/Q < 1.2)

Undersized
(q/Q > 1.2)

Manhole Deficiencies

Potential Overflow
(Rim Elev. - HGL) < 3.0

Normal

FIGURE A5

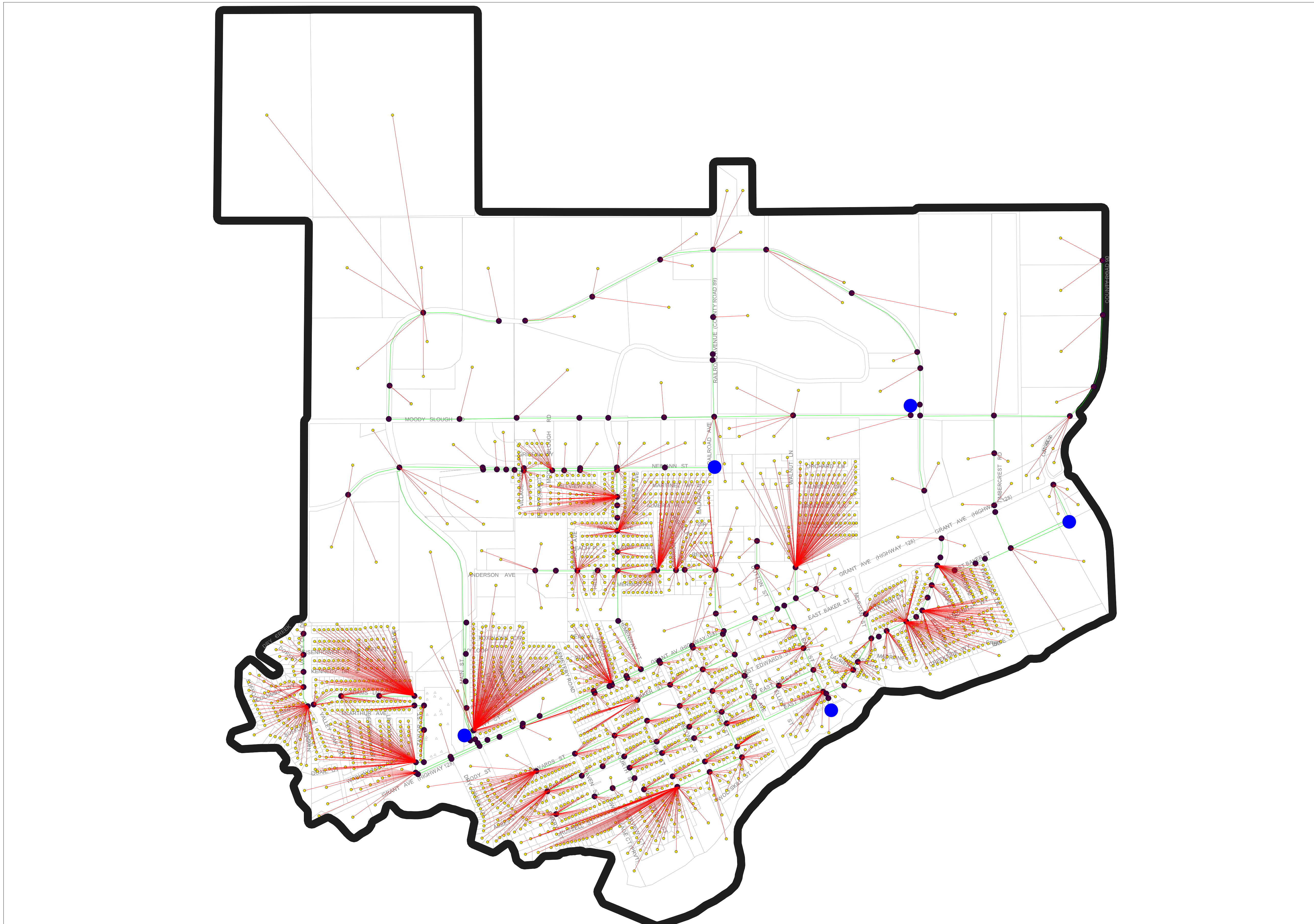
H2OMap Sewer Modeling Results for Buildout PWWF

CITY OF WINTERS
Sewer Master Plan

N

0 0.2 0.4 Miles

FIGURE A6: Load Allocation for Future Sewer Collection System



LEGEND

Urban Limits

Pump Station

Modeled Manholes

Modeled Sewers

FIGURE A6

Load Allocation for Future Sewer Collection System

CITY OF WINTERS
Sewer Master Plan

N

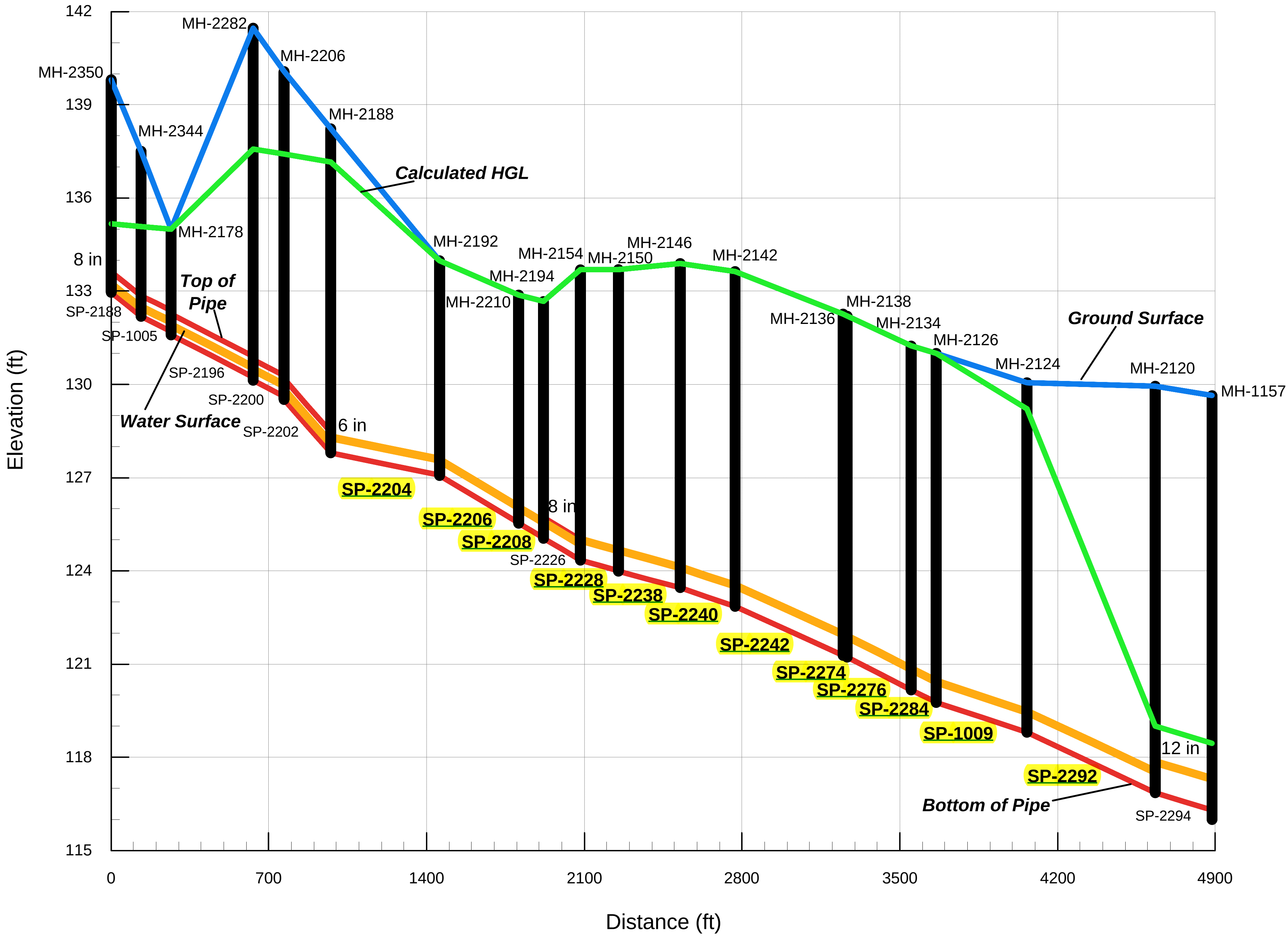
Prepared By: mtl

2004/08

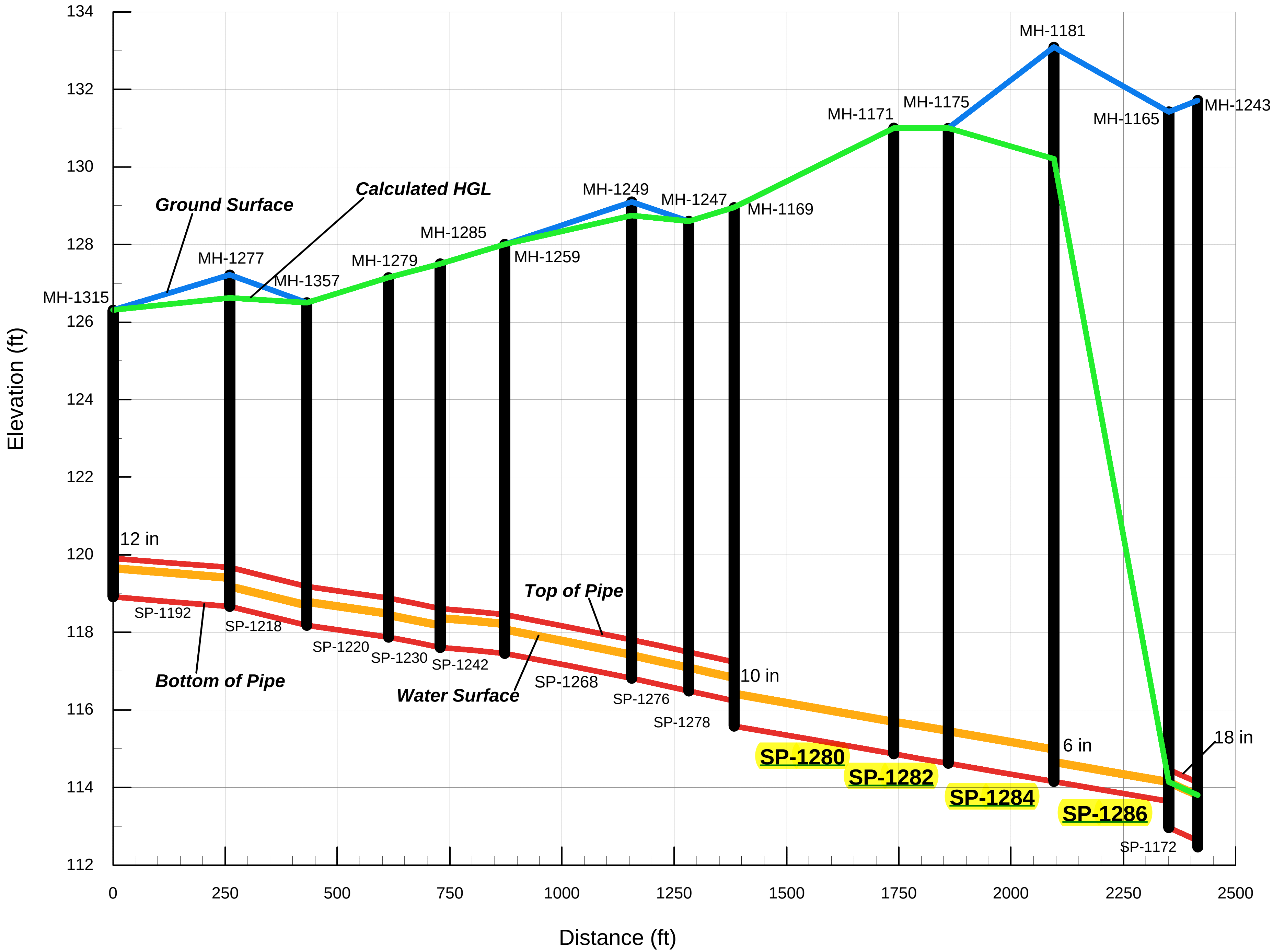
ATTACHMENT B

Hydraulic Profiles

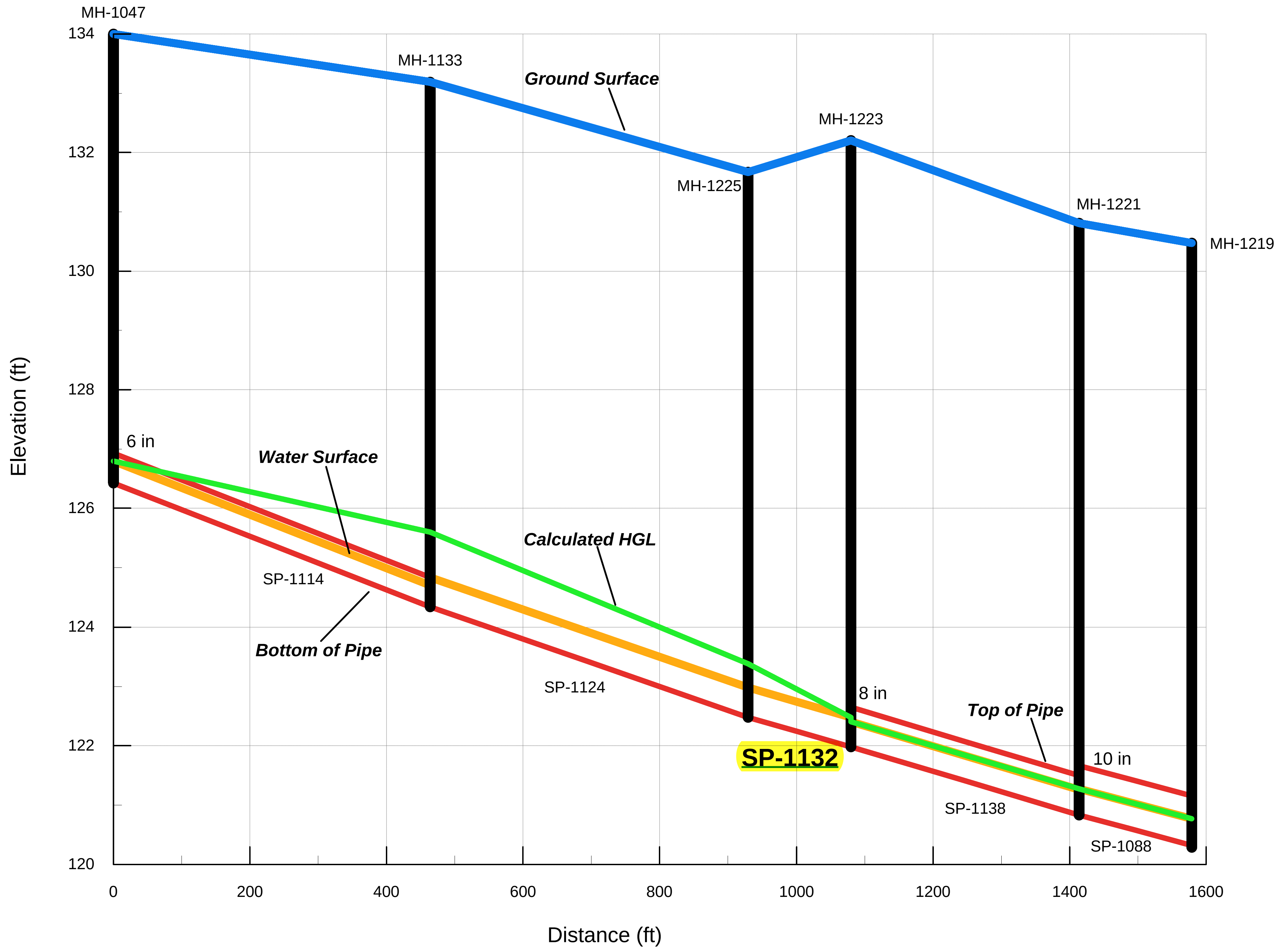
Profile for Location 1



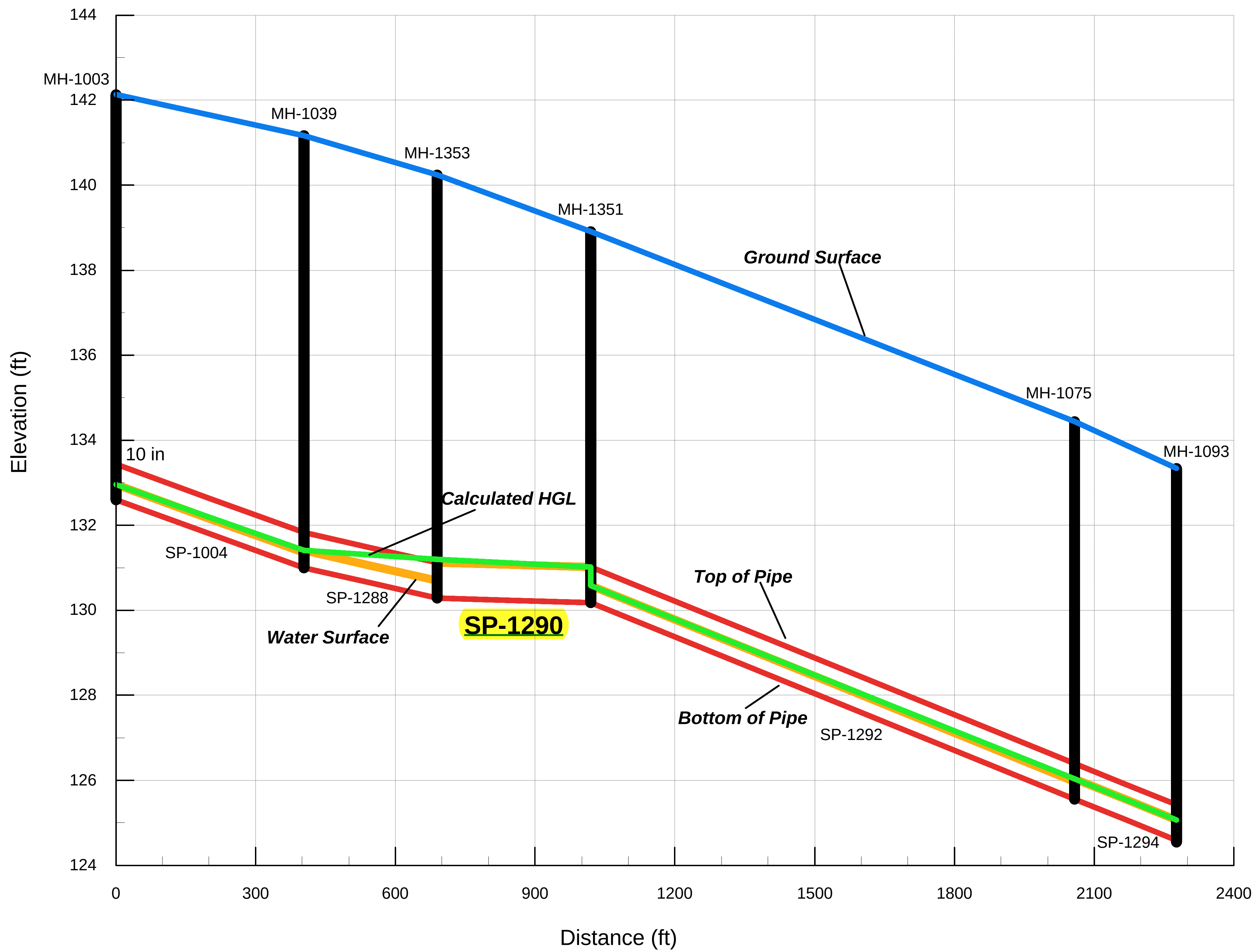
Profile for Location 2



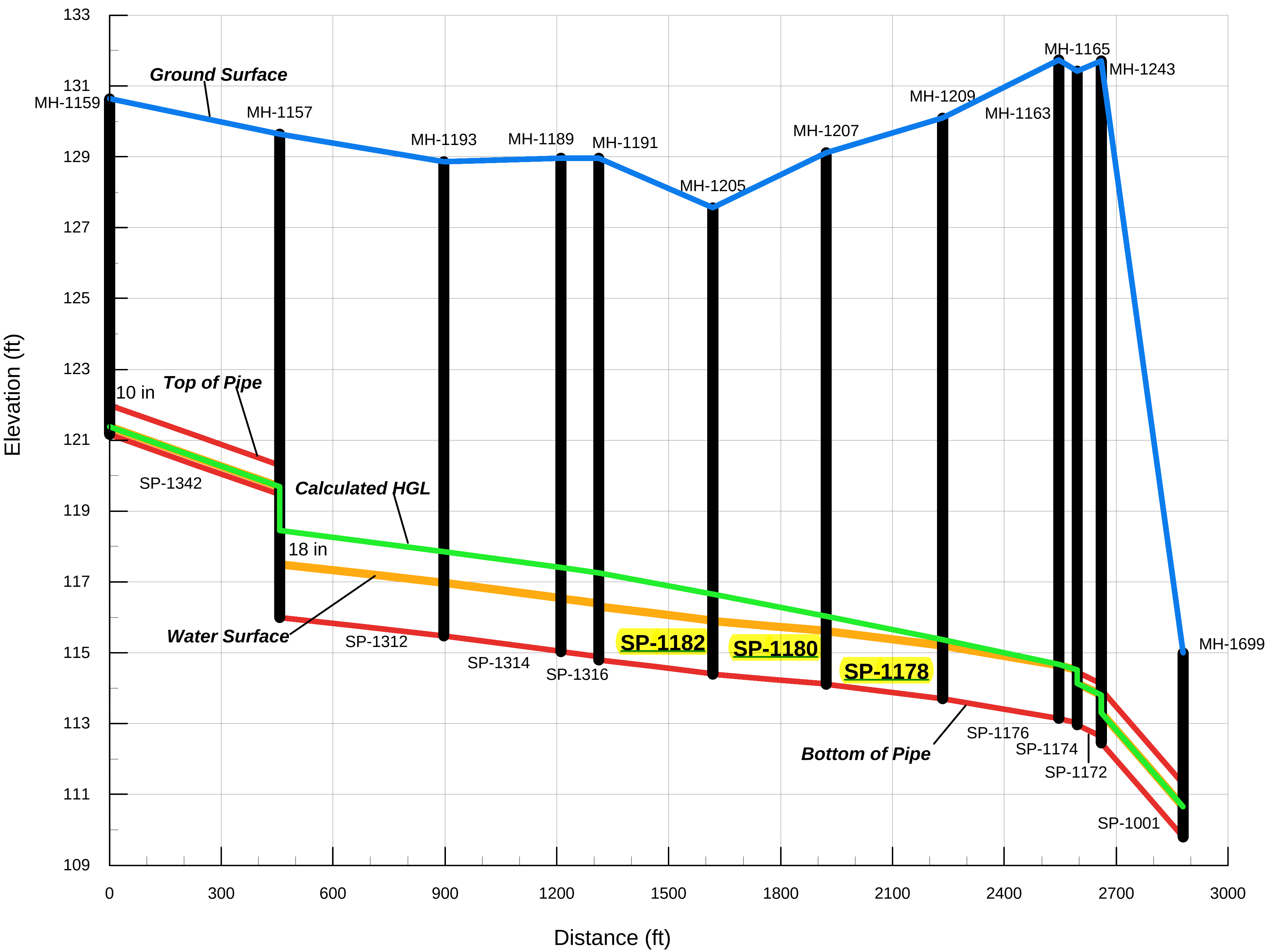
Profile for Location a



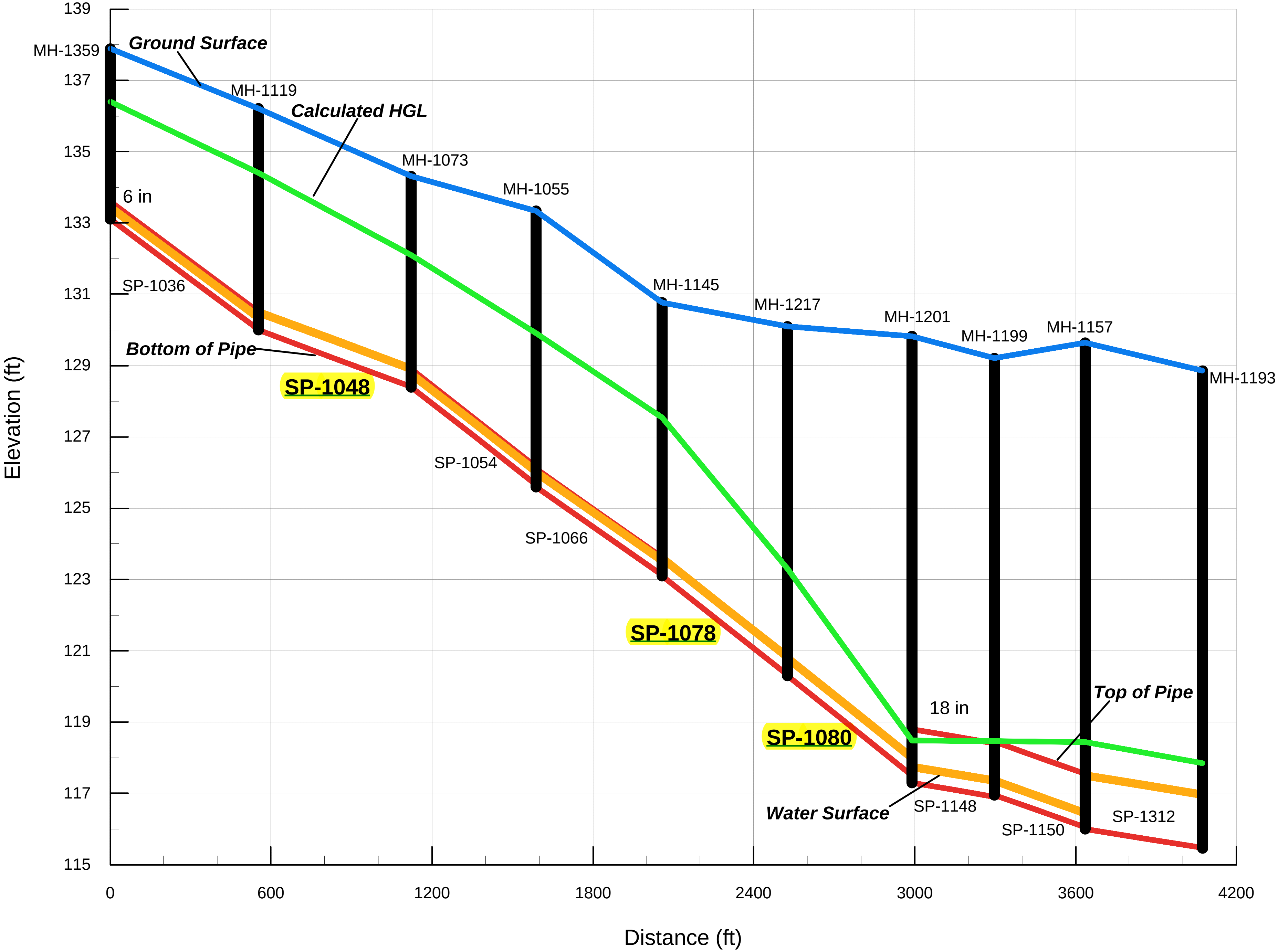
Profile for Location b



Profile for Location c



Profile for Location d



FINAL Technical Memorandum

Southwest Corner Callahan Estates Pump Station Analysis

Subject: **Initial Model Results of SWCCE Pump Station Scenario**

Prepared For: Nick Ponticello, City of Winters

Prepared by: Glenn Hermanson, RMC

Reviewed by: Andy Smith, RMC

Date: May 23, 2006

Reference: RMC 0098-02

1 Introduction

This TM presents the initial results of the analysis to evaluate the scenario of locating a pump station at the southwest corner of Callahan Estates (SWCCEPS). For the purposes of this TM, the following terms will be used:

Railroad PS Scenario: This is the currently proposed sewer configuration. The main component of the scenario is a proposed pump station on Railroad Street near Neimann Street. The Carter Ranch Pump Station collects sewage from Carter Ranch, Callahan Estates, and Ogando Hudson and pumps north through a 3,640 foot long force main to a new gravity sewer in the Winters Highlands area and flows east along Neimann Street to the proposed pump station (referred to as the "Railroad Pump Station" in this TM). In order to solve the reach of over-loaded sewers (location 1 in master plan), 3,510 feet of existing sewers along Neimann, Hemenway, Anderson, and Railroad are proposed to be upsized.

SWCCEPS Scenario: This is the proposed alternative sewer configuration. The main component of the scenario is a proposed pump station at the southwest corner of Callahan Estates (SWCCEPS). The Carter Ranch Pump Station lifts sewage into the existing dry gravity sewer in Main Street which flows north to the new SWCCEPS located near the storm drain detention basin. The SWCCEPS will serve Callahan, Winters Highland, and the western parcels north of Moody Slough. This pump station pumps directly to the WWTP in a new force main. In order to reduce the flow to the over-loaded sewers in Hemenway, Anderson, and Railroad, a new gravity sewer will extend from Neimann and Hemenway to Railroad and across a soon-to-be-developed parcel to Dutton Street. A new sewer at Adams and Taylor (upstream of the trailer park) diverts flow north and east to the SWCCEPS which reduces the amount of flow in Grant Avenue and onward to the East Street Pump Station.

2 Analysis

A "pump station shed map" for both scenarios is included in Attachment A. Figures of the various profiles are included in Attachment B.

2.1 "Corrections" to Railroad PS Scenario

The following modifications were made to the Railroad PS Scenario presented in the December 2004 Master Plan.

- The trailer park north of Grant Avenue is now loaded at the "backyard manhole" at the northwest corner of the trailer park (MH-2084).
- Creekside development is now loaded to the 10" sewer on Grant Avenue.
- Waggoner Elementary School is now loaded to Edwards Ave/St instead of Grant Avenue.

2.2 Load Allocation

The load allocation sheets are included in Attachments C and D.

2.3 Backyard Sewer Parallel to Taylor Street

The profile of the backyard sewer parallel to Taylor Street with Railroad PS Scenario loadings is presented in **Figure 1**. This profile includes flows from the trailer park and shows that this sewer is not overloaded. During a recent public meeting, a trailer park representative stated that this sewer is overloaded during rain events. The best explanation is that the backyard sewer is partially clogged with roots and/or grease and needs to be thoroughly cleaned. The SWCCEPS Scenario would reduce the flow to this sewer segment but would not reduce the possibility of an overflow since an overflow in this sewer would be caused by a clog, not inadequate capacity.

2.4 Railroad/Anderson/Hemenway/Neimann Sewer (i.e. Location 1)

Figures 2 and 3 present the profiles of the existing sewer along Neimann, Hemenway, Anderson, and Railroad with Railroad PS Scenario and SWCCEPS Scenario loadings respectively. The flow diversion to Dutton Street reduced the amount of surcharging drastically. The SWCCEPS Scenario does have a long reach of surcharging, but the surcharging is minor (less than 18-inches) and the HGL remains at least nine feet below the ground surface. With the SWCCEPS Scenario, additional improvements to these sewers are not necessary.

It should be pointed out that a slight modification to the Railroad PS Scenario would also eliminate the need for these additional improvements. The modification would be to divert the flow at Neimann Street and Hemenway Street and convey that flow to the Railroad PS.

2.5 East Street Trunk (i.e. Location c)

Figures 4 and 5 present the profiles of the existing sewer along East Street from the pump station to Grant and on to Railroad Avenue with Railroad PS Scenario and SWCCEPS Scenario loadings respectively. The profiles are essentially the same with only slight surcharging. The SWCCEPS Scenario has less surcharging at Grant and Railroad.

2.6 Neimann/Dutton Sewer

Figure 6 presents the profile of the proposed sewer (SWCCEPS Scenario) from Neimann Street to Railroad Avenue, across the parcels to be developed to Dutton Street, and south to the existing 8-inch sewer on Dutton. On the profile, MH 2192 is the existing manhole at Neimann Street and Hemenway Street. The last segment in on Grant Avenue and shows the slight surcharge described in section 2.5 above. The amount of flow in Dutton Street is 480 gpm and the existing 8-inch sewers do not have enough capacity to convey this flow. The resulting surcharge is shown in the profile and is not acceptable.

Figure 7 presents the same profile except the existing 8-inch sewers on Dutton have been replaced with new 10-inch sewers. There is no surcharging except for the backwater effect from Grant Avenue. Based on the modeled loading, these pipes, in addition to the first pipe segment upstream on Dutton, should be 10-inch in diameter, and should be placed at a slope of 0.0025. The remaining pipes along this new line should be 8-inch in diameter and should be placed at a slope of 0.0033. The length of new 10-inch is 1,170 feet and the length of new 8-inch sewer is 2,540 feet.

2.7 Main Street Sewer Downstream of CRPS

Figure 8 presents the profile of the existing (currently dry) 8-inch sewer in Main Street from the Carter Ranch Pump Station (CRPS) to the SWCCEPS with SWCCEPS Scenario loadings. The last segment has less slope than the other segments and has minor (4-inches) of surcharging. This small amount of surcharging during PWWF buildout flows is acceptable.

2.8 Lots Along Neimann Street

On the north side of Neimann Street there are a number of undeveloped lots. **Figure 9** presents the profile of the sewer on Neimann Street between Railroad Street and Hemenway Street. Identifying the lots from 1 to 4 with 1 being closest to Railroad Street, the amount of cover is shown in the table below:

Table 1: Sewer Cover on Neimann Street Near Railroad Avenue

Lot	Amount of Cover (feet)
1	5.6
2	5.3
3	4.5
4	3.5

The 3.5 feet of cover (rim to top of pipe) shown for Lot 4 is the amount of cover at the existing manhole at intersection of Neimann Street and Hemenway Street. This is not enough cover to adequately serve these parcels. This appears to be a fatal flaw for the SWCCEPS Scenario. It may be possible to construct a deeper parallel sewer to serve these lots with a small lift (similar to Walnut Lane Lift Station) that would lift the sewage into the Neimann Street Sewer. This lift station would not require any standby power because if a power outage were to occur, the sewage would surcharge up to an elevation where it would passively flow into the Neimann Street sewer.

2.9 Carter Ranch Pump Station

The flow from the CRPS is 354 gpm in the Railroad PS Scenario and 169 gpm in the SWCCEPS Scenario. The SWCCEPS Scenario does not add any flows to the CRPS that were not anticipated when the pump station was designed. Although the pump station was designed for a flow of 125 gpm, the design also included a passive overflow from the wet well to the gravity sewer on Main Street. For these reasons, the SWCEEPS Scenario does not include any improvements to the CRPS.

The Railroad PS Scenario includes improvements to the CRPS and a new force main.

2.10 SWCCE Pump Station

The flow from the SWCCEPS is 1,250 gpm in the SWCCEPS Scenario.

2.11 East Street Pump Station

The flows to the East Street Pump Station (ESPS) are essentially the same for both alternative, 3,110 and 3,130 gpm for the Railroad PS Scenario and SWCCEPS Scenario, respectively. The capacity of the ESPS is approximately 2,600 gpm, therefore the ESPS would need to be expanded in both alternatives.

An alternative to expansion of the ESPS would be to implement the following two modifications to the Railroad PS Scenario.

- Route the future Gateway force main north to the proposed gravity sewer on Main Street north of Grant Ave., which flows north to the future pump station on Moody Slough Rd. This would divert 308 gpm from the ESPS.
- Divert all the flow from the Grant Avenue sewers to the CRPS as they pass Main Street near the CRPS. This would divert 390 gpm. This would require a new sewer from Grant Avenue to the CRPS.

2.12 East Street Force Main

The design flows in the East Street Force Main are essentially the same for both alternatives. An updated analysis of the ESFM was performed using the design flows of 3,110 and 3,130 gpm as part of this evaluation. The results show that as long as the Hazen-Williams friction factor ‘C’ does not drop below 100, the pressures within the ESFM are acceptable, although quite near the design parameters of the force main. The recommendation in the draft Master Plan to measure and monitor the headloss in the force main (and using the data to calculate the friction coefficient) continues to be applicable.

A break in the East Street Force Main is an event that may occur for a variety of reasons, the most common of which is being accidentally broken by a contractor excavating in the vicinity of the force main. For this reason, it is prudent to either have a parallel force main, a Force Main Rupture Plan, or both. There is an old clarifier at the East Street Pump Station which will contain flows for a short time (about an hour), but shouldn’t be the only component of a Force Main Rupture Plan.

3 Alternative Comparison

The alternatives are compared in the table below.

Description	Railroad PS Scenario	Modified Railroad PS Scenario(1)	SWCCEPS Scenario
Anderson Ave/Hemenway St Sewer Upsize	Yes	No	No
Neimann St to Dutton Street Sewer	No	No	Yes
Deeper Parallel Sewer and PS in Neimann	No	No	Yes
SWCCE Pump Station	No	No	Yes
SWCCE Pump Station Force Main	No	No	Yes
Railroad Pump Station	Yes	Yes	No
Railroad Pump Station Force Main	Yes	Yes	Maybe(2)
Carter Ranch Pump Station Expansion	Yes	Yes	No
Carter Ranch Pump Station Force Main	Yes	Yes	No
Moody Slough Pump Station	Yes	Yes	Larger

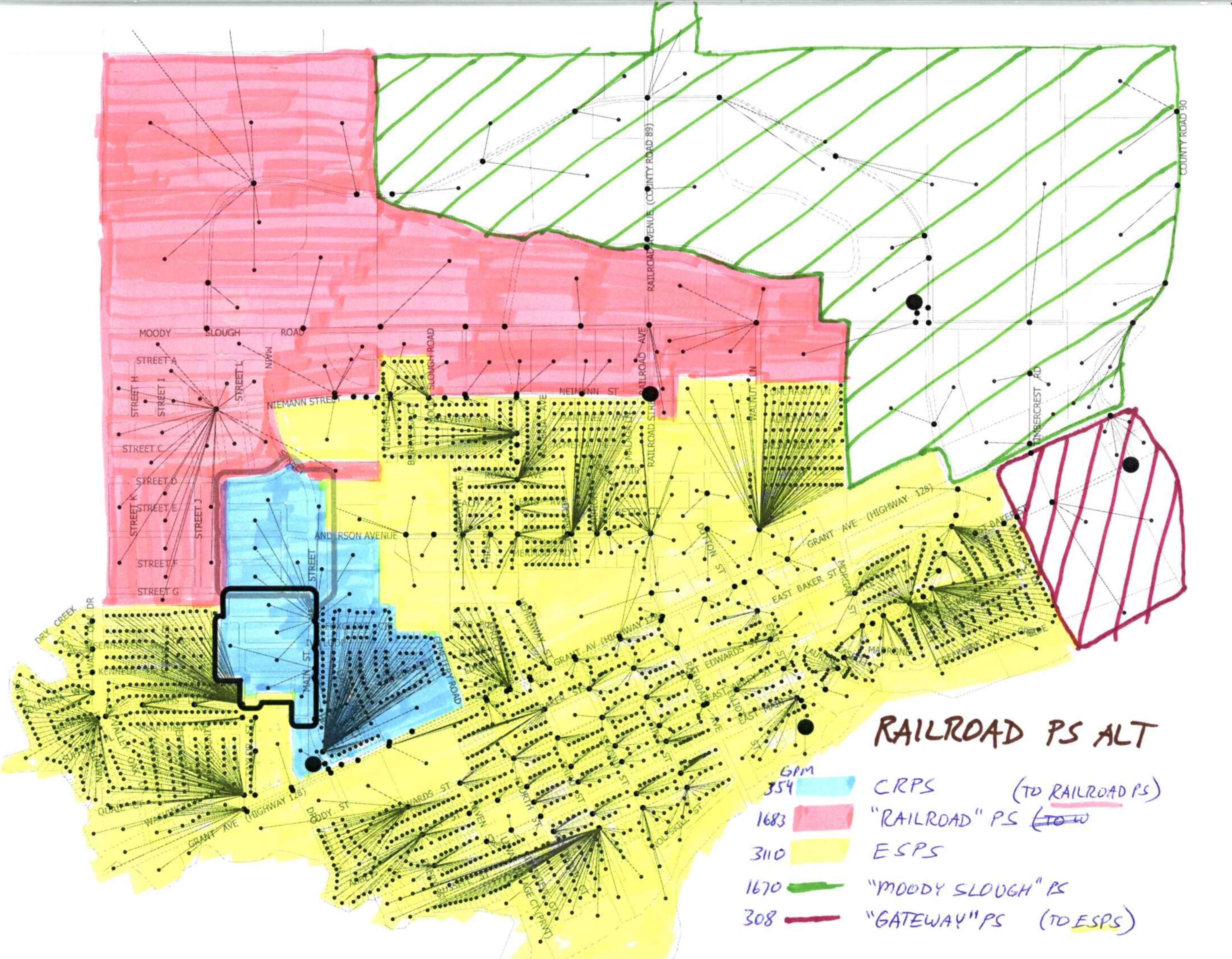
(1) The “Modified” Railroad PS Scenario diverts the flow from the existing manhole at Neimann and Hemenway and conveys it to the Railroad PS.
(2) A parallel force main to the existing East Street Force Main should be constructed as discussed in Section 2.12 above.

4 Recommendation

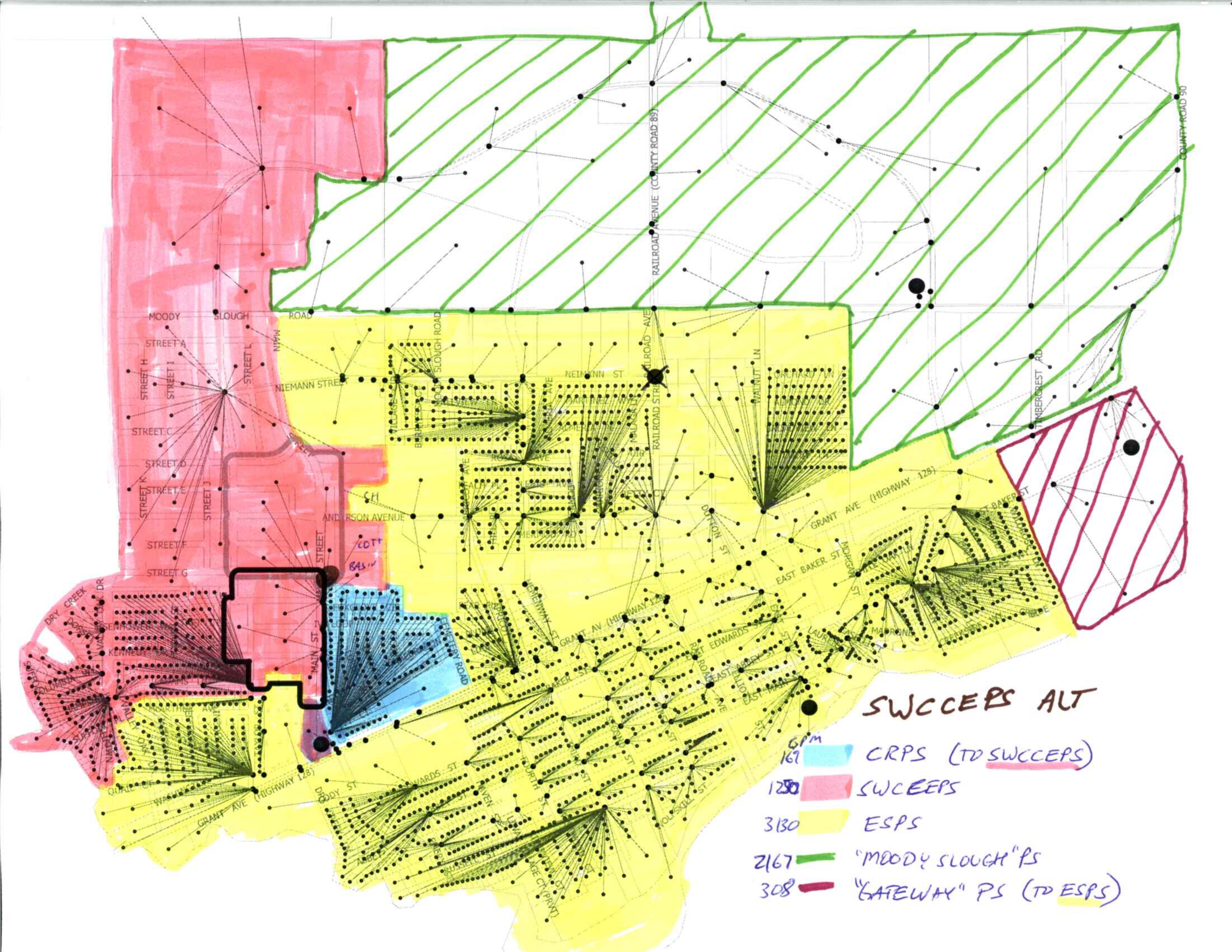
All three alternatives are feasible and approximately equal. While a rigorous comparison of all alternatives was not performed, the Modified Railroad Pump Station Scenario appears to be slightly better than the other two because it has less flow to the ESPS and it can serve the lots north of Neimann without a pump station.

Attachment A

Pump Station Shed Map



RAILROAD PS ALT
GPM
354 CRPS (TO RAILROAD PS)
1683 "RAILROAD" PS ~~TO W~~
3110 ESPS
1670 "MOODY SLOUGH" PS
308 "GATEWAY" PS (TO ESPS)
MOODY SLOUGH ROAD
STREET A
STREET B
STREET C
STREET D
STREET E
STREET F
STREET G
STREET H
STREET I
STREET J
STREET K
STREET L
MAIN
NIEMANN STREET
NEIMANN ST
SLOUGH ROAD
RAILROAD AVENUE (COUNTY ROAD 89)
RAILROAD AVE
RAILROAD ST
COUNTY ROAD 90
TIMBERCREST RD
ORCHARD LN
WALNUT LN
ANDERSON AVENUE
GRANT AVE (HIGHWAY 128)
GRANT AV (HIGHWAY 128)
EAST BAKER ST
EAST EDWARDS ST
EAST MAIN ST
DAYTON ST
MAIN ST
DRY CREEK DR
MACARTHUR AVE
DODY ST
EDWARDS ST


SWCCEPS ALT
GPM
167 CRPS (TO SWCCEPS)
1250 SWCEEPS
3130 ESPS
2167 "MOODY SLOUGH" PS
308 "GATEWAY" PS (TO ESPS)
MOODY SLOUGH ROAD
STREET A
STREET H
STREET I
STREET L
STREET C
STREET D
STREET E
STREET F
STREET G
STREET K
STREET J
NIEMANN STREET
NEIMANN ST
ANDERSON AVENUE
RAILROAD AVENUE (COUNTY ROAD 89)
COUNTY ROAD 90
TIMBERCREST RD
WALNUT LN
ORCHARD LN
GRANT AVE (HIGHWAY 128)
GRANT AV (HIGHWAY 128)
EAST BAKER ST
EAST EDWARDS ST
DUTTON ST
MORGAN ST
CEMETERY ROAD
MAIN ST
MAIN STREET
DRY CREEK
MOODY ST
RAILROAD AVE
COTT BASIN
CH

Attachment B

Profiles

RRPS: Backyard Sewer Parallel to Taylor Street

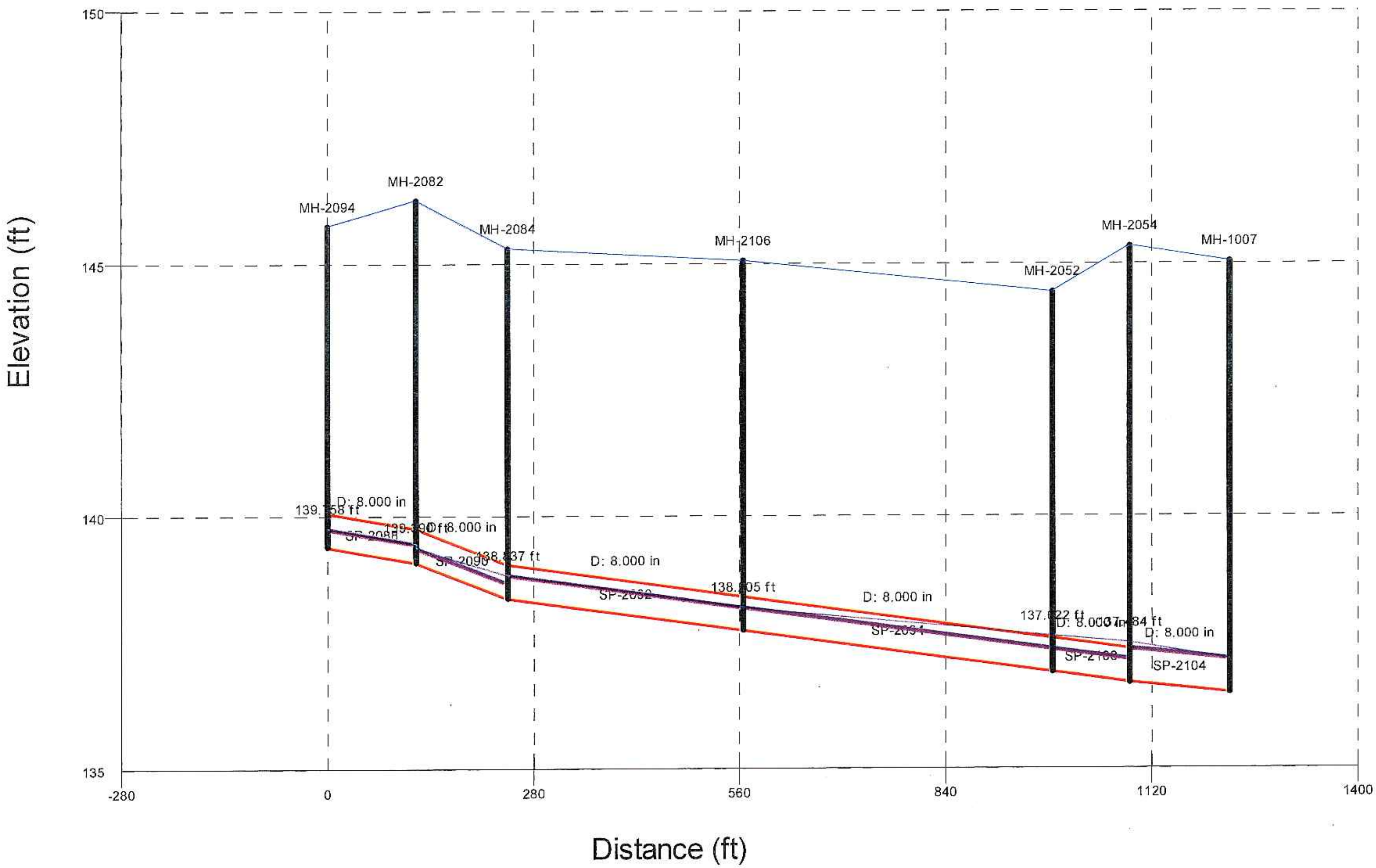


Figure 1

RRPS: Railroad/Anderson/Hemenway/Niemann Sewer

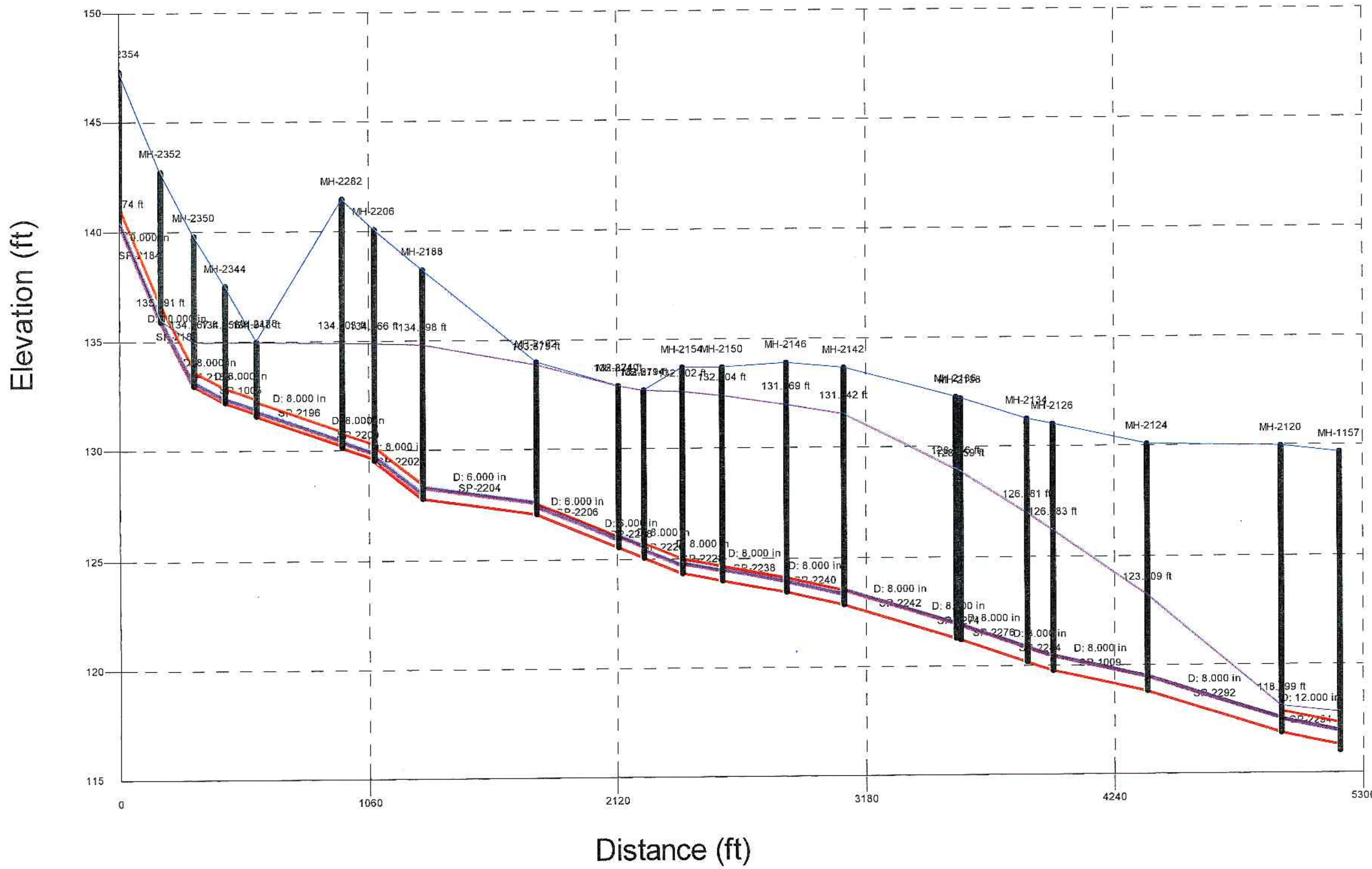


Figure 2

SWCCEPS: Railroad/Anderson/Hemenway/Niemann Sewer (Niemann portion only)

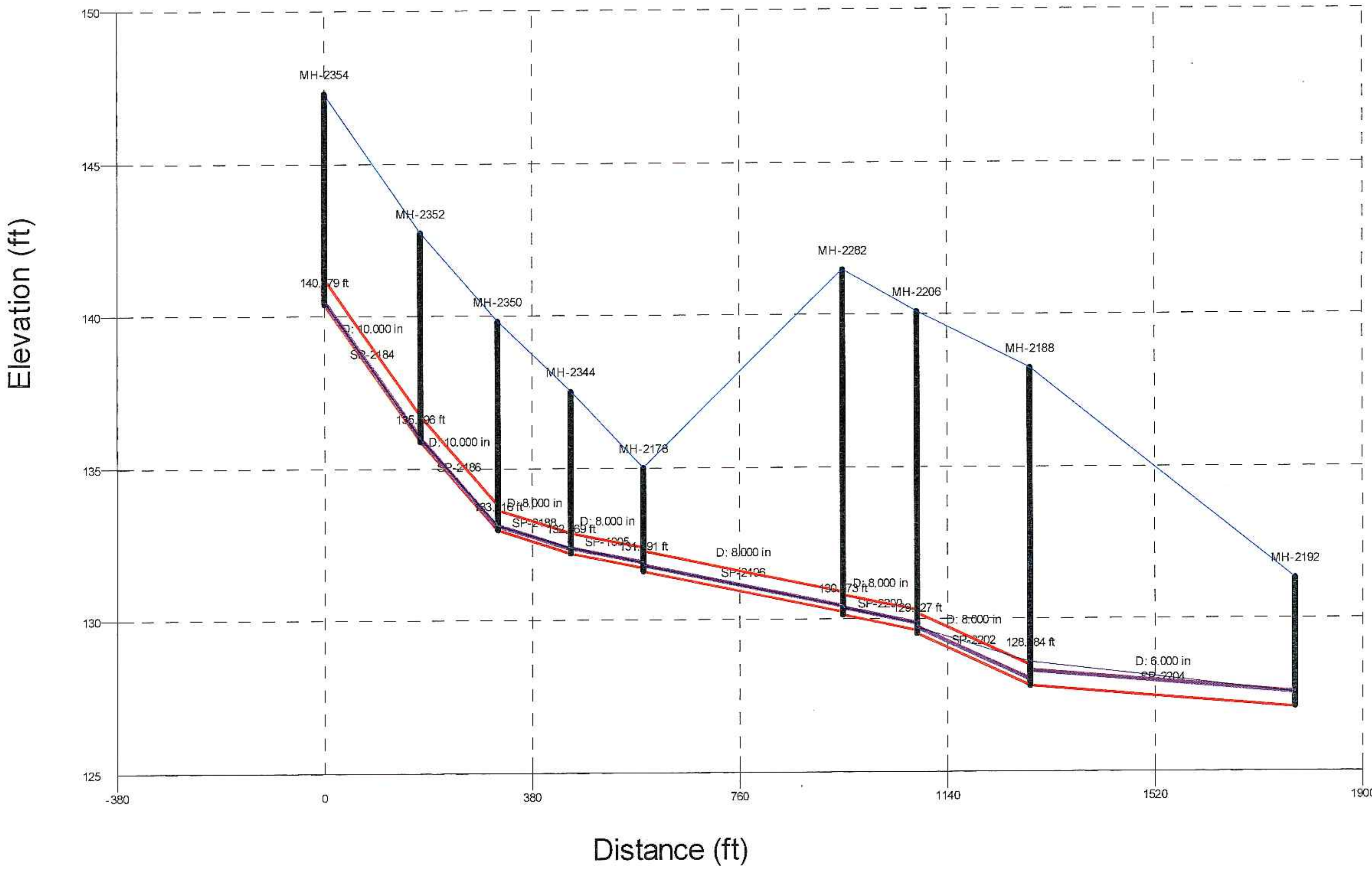


Figure 3a

SWCCEPS: Railroad/Anderson/Hemenway/Niemann Sewer (Hemenway to Railroad only)

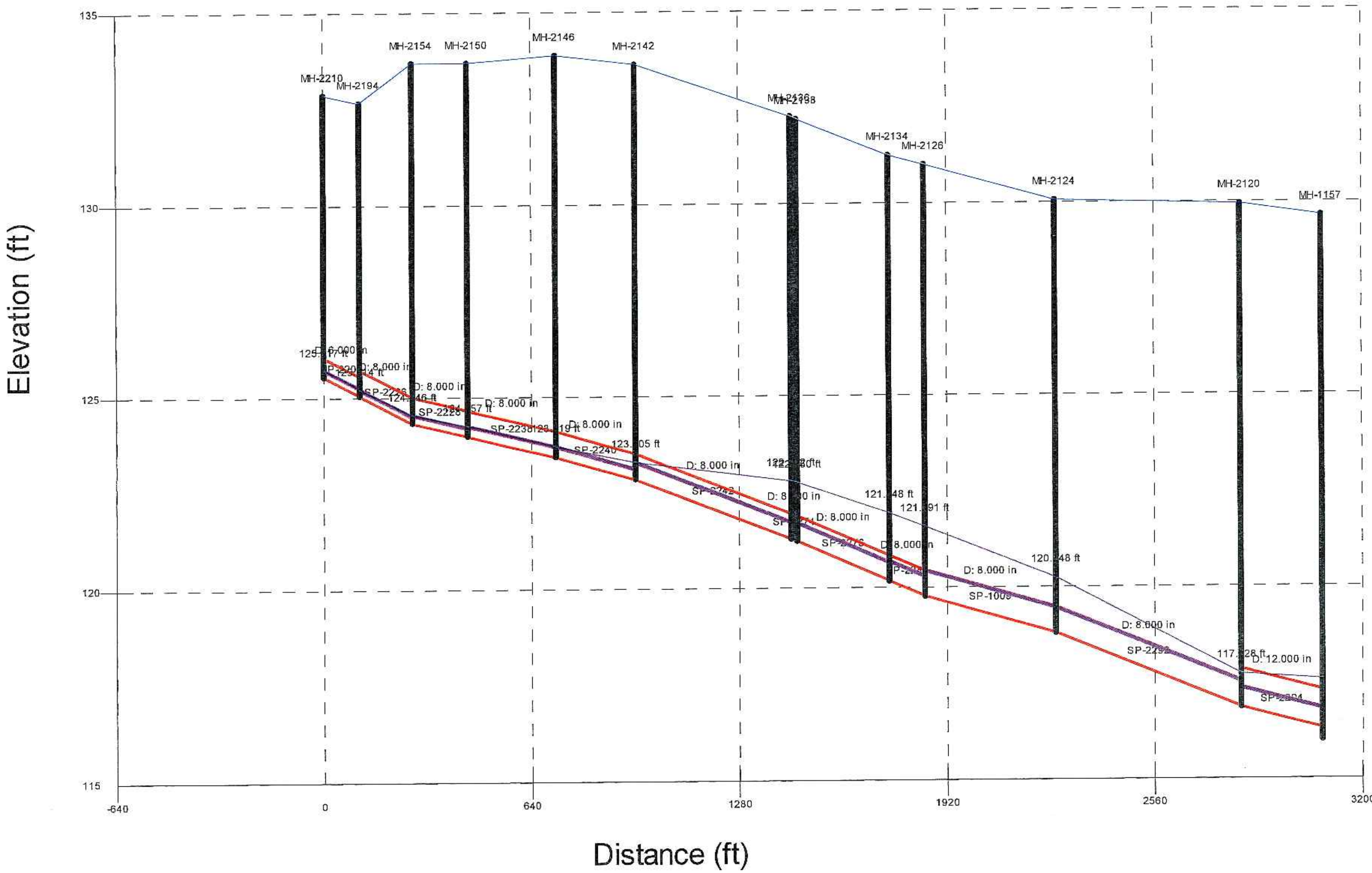


Figure 3b

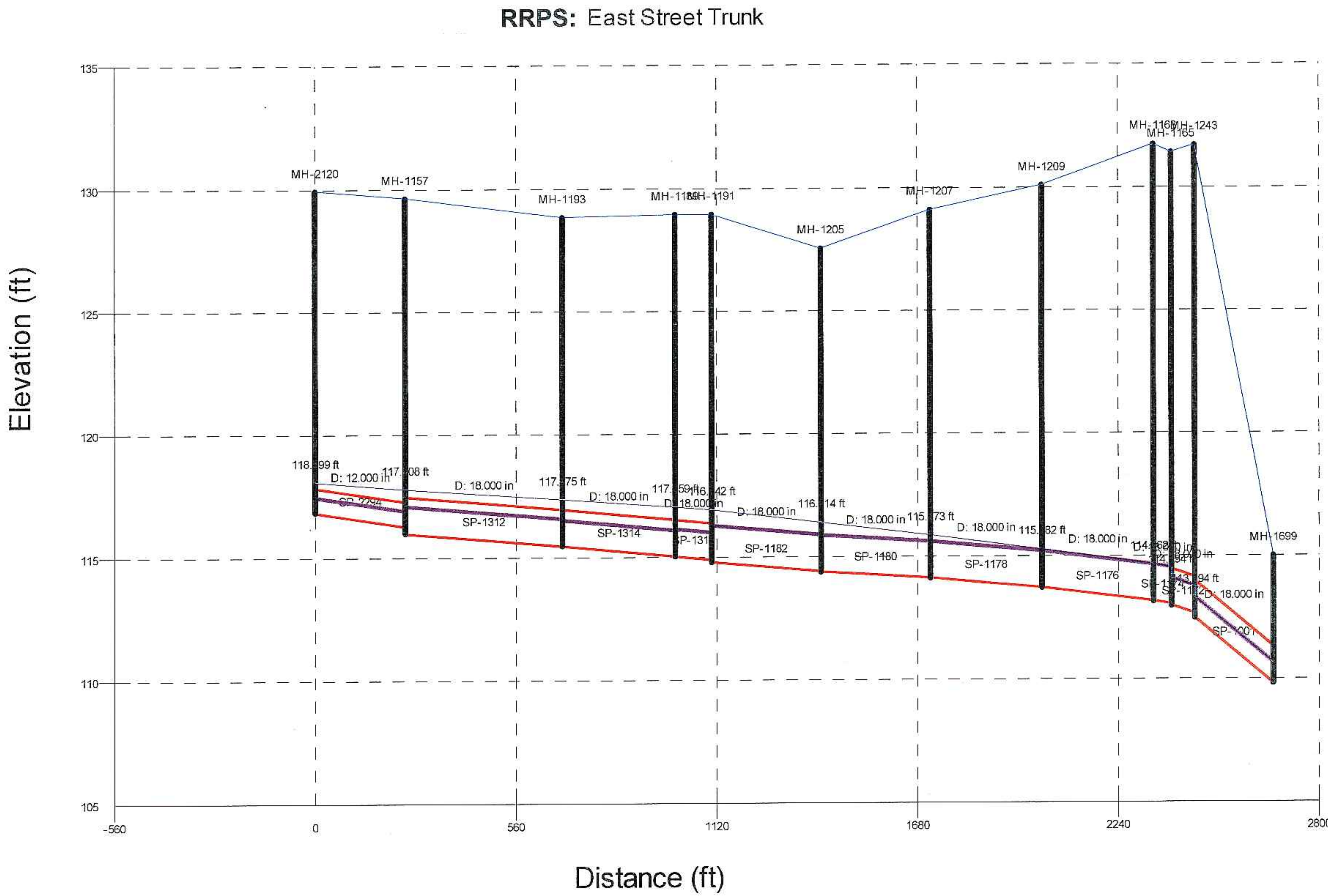

RRPS: East Street Trunk
Elevation (ft)
Distance (ft)
135
130
125
120
115
110
105
-560
0
560
1120
1680
2240
2800
MH-2120
MH-1157
MH-1193
MH-1205
MH-1207
MH-1209
MH-1165
MH-1243
MH-1699
D: 12.000 in
D: 18.000 in
SP-1312
SP-1314
SP-1182
SP-1180
SP-1178
SP-1176

Figure 4

SWCCEPS: East Street Trunk

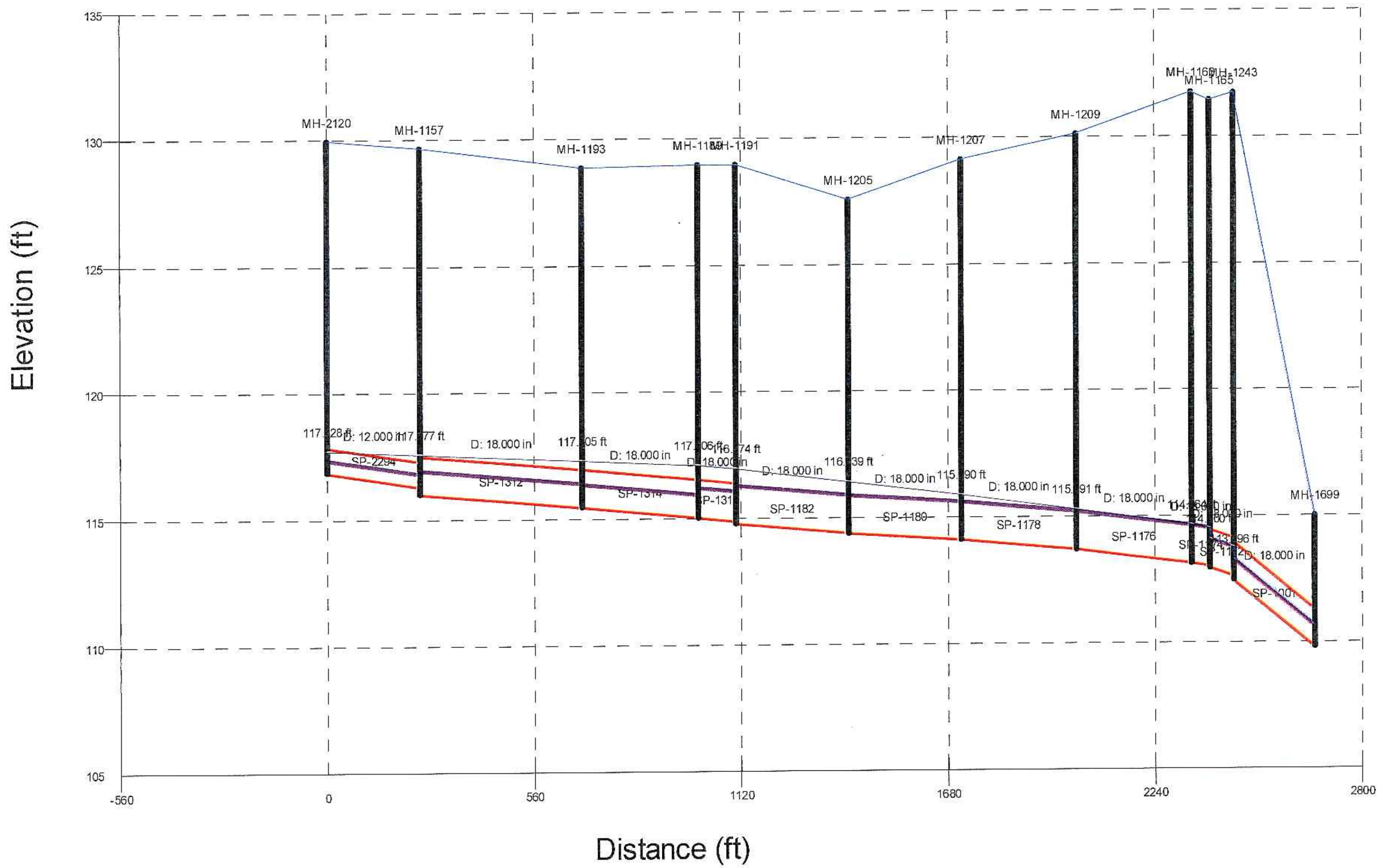


Figure 5

SWCCEPS: Niemann/Dutton - Connect to Existing

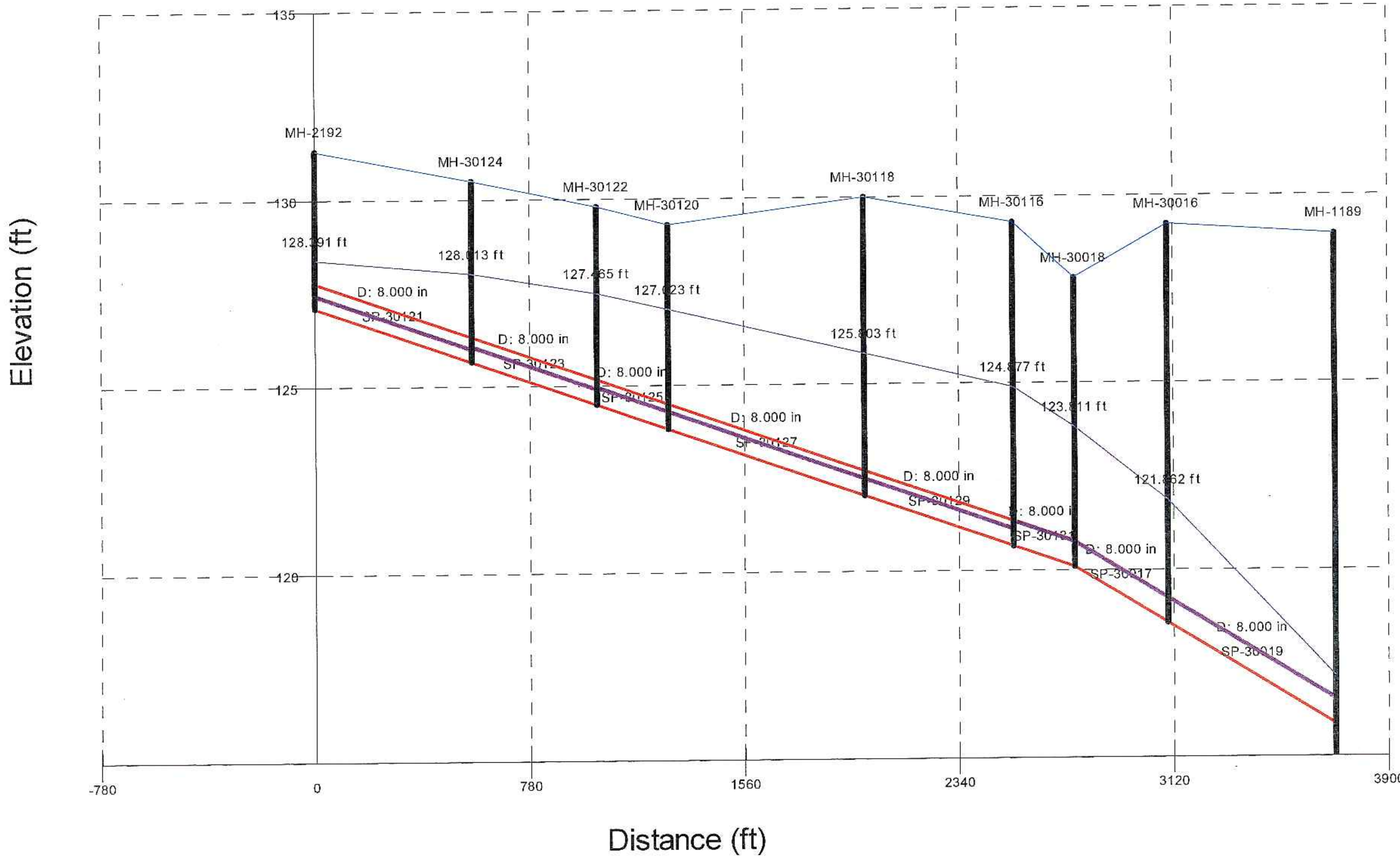


Figure 6

SWCCEPS: Niemann/Dutton - Proposed

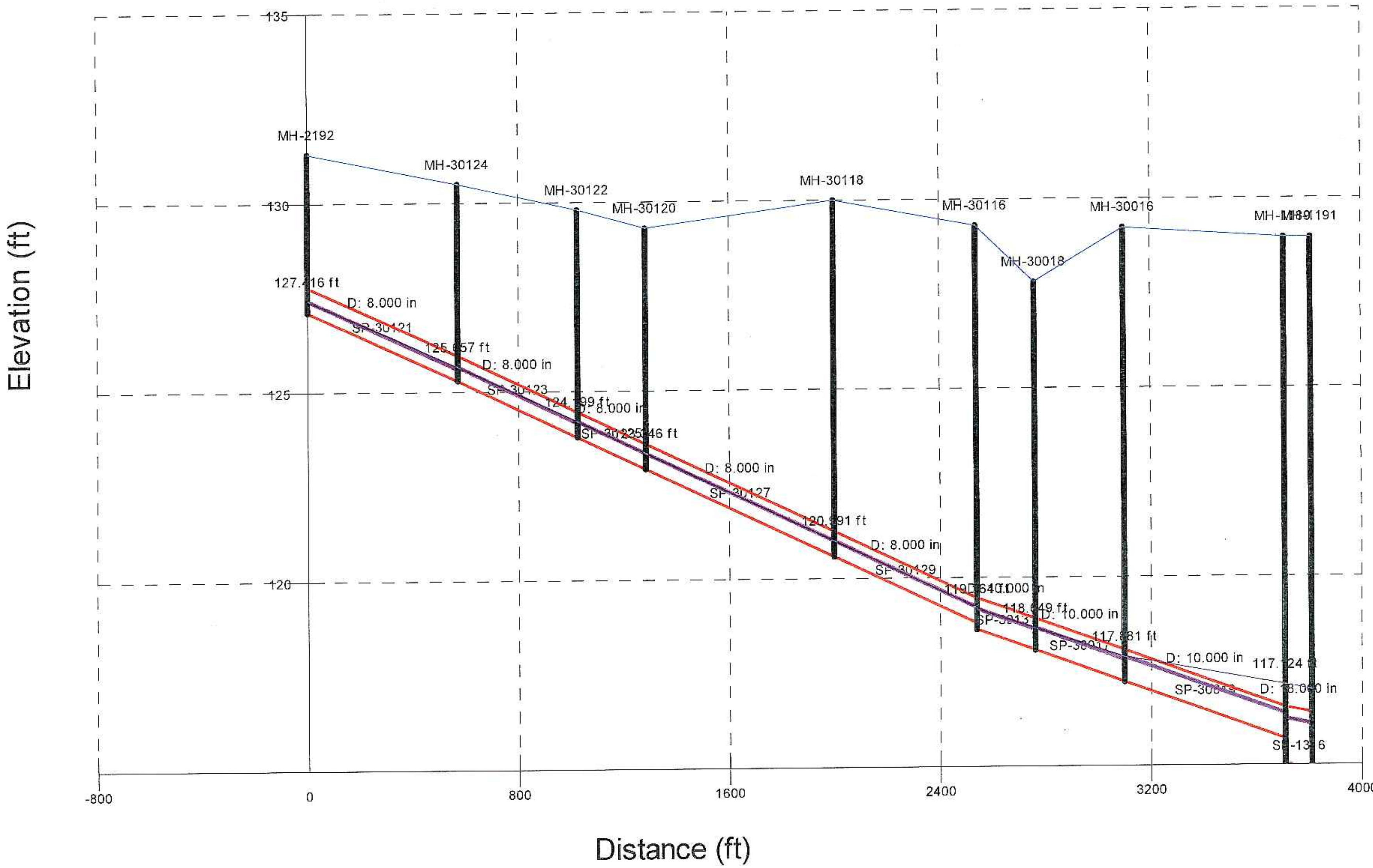


Figure 7

SWCCEPS: Main Street Sewer Downstream of CRPS

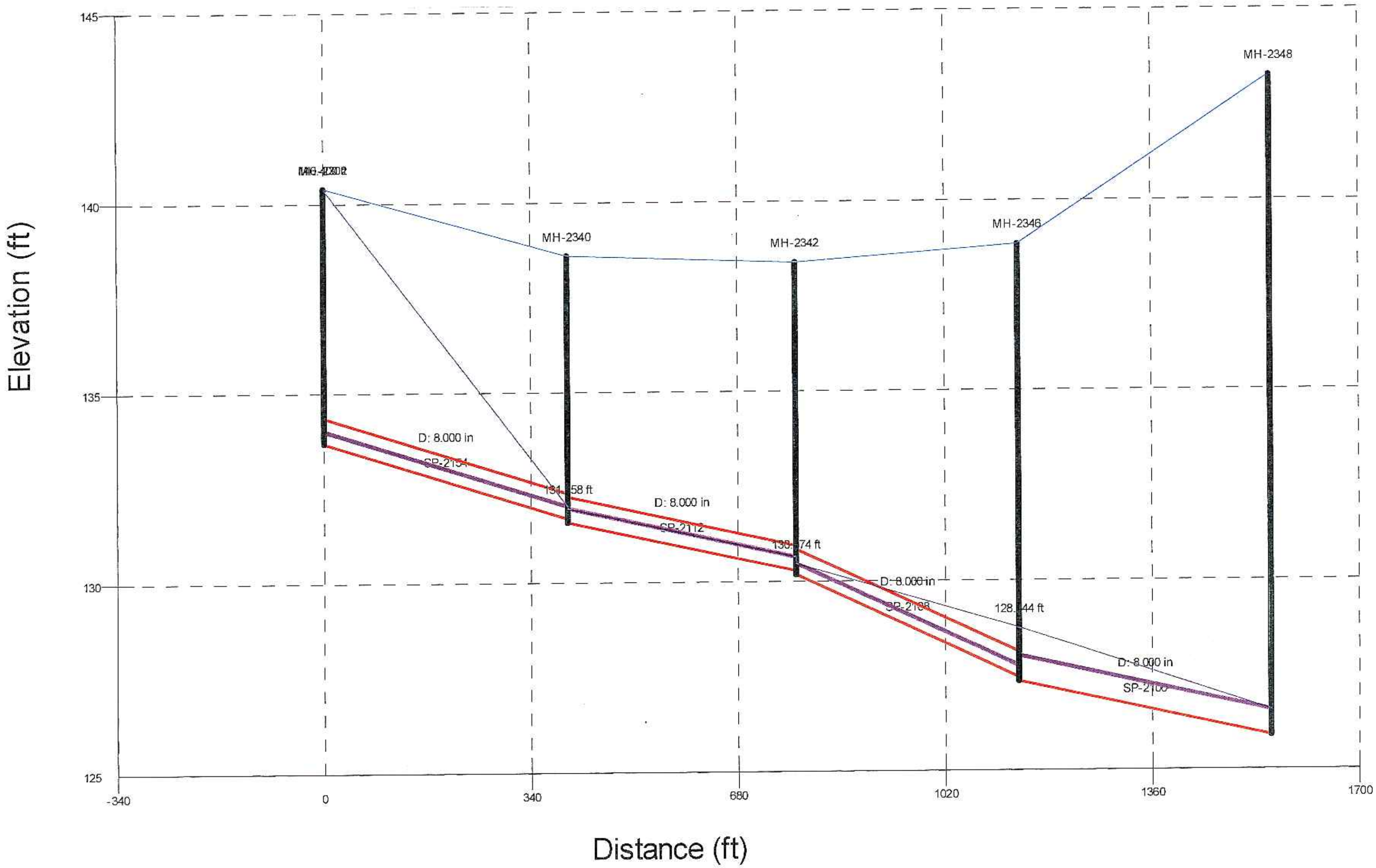


Figure 8

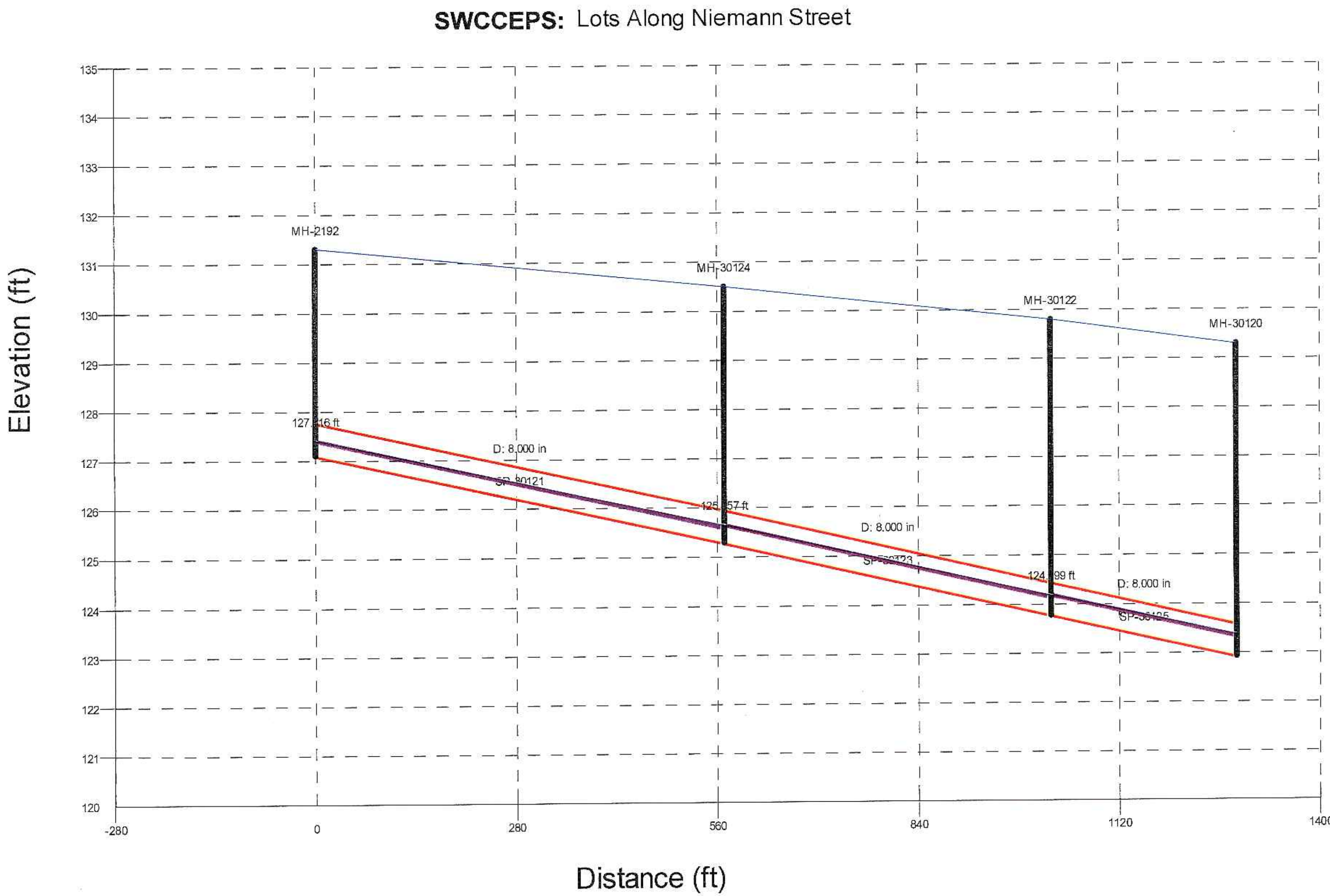

SWCCEPS: Lots Along Niemann Street
Elevation (ft)
Distance (ft)
MH-2192
MH-30124
MH-30122
MH-30120
D: 8.000 in
D: 8.000 in
D: 8.000 in

Figure 9

Attachment C

Load Allocation Figures: Railroad PS Scenario

Load Allocation Overview

Railroad PS Scenario

SW Corner

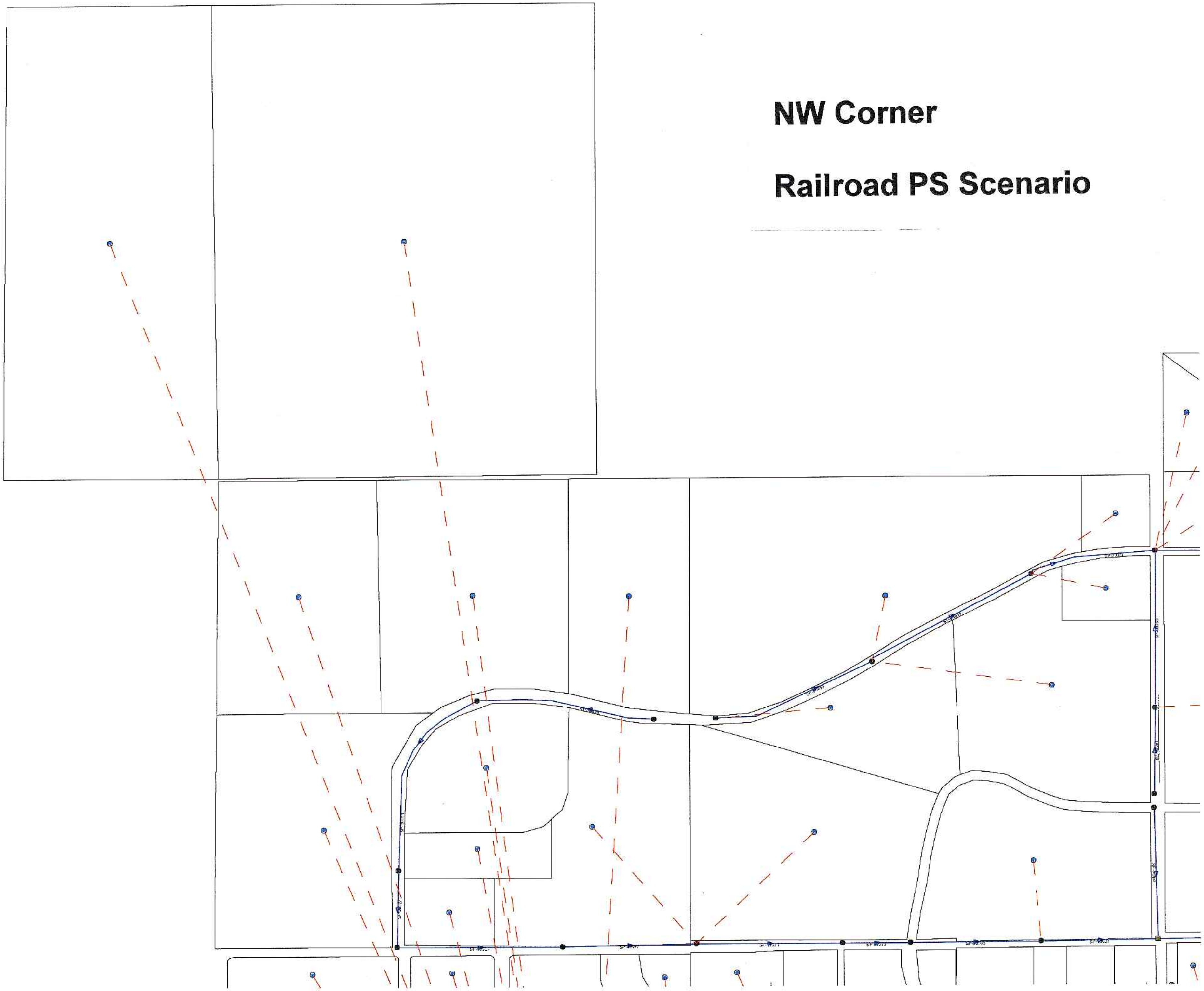
Railroad PS Scenario

SE Corner

Railroad PS Scenario

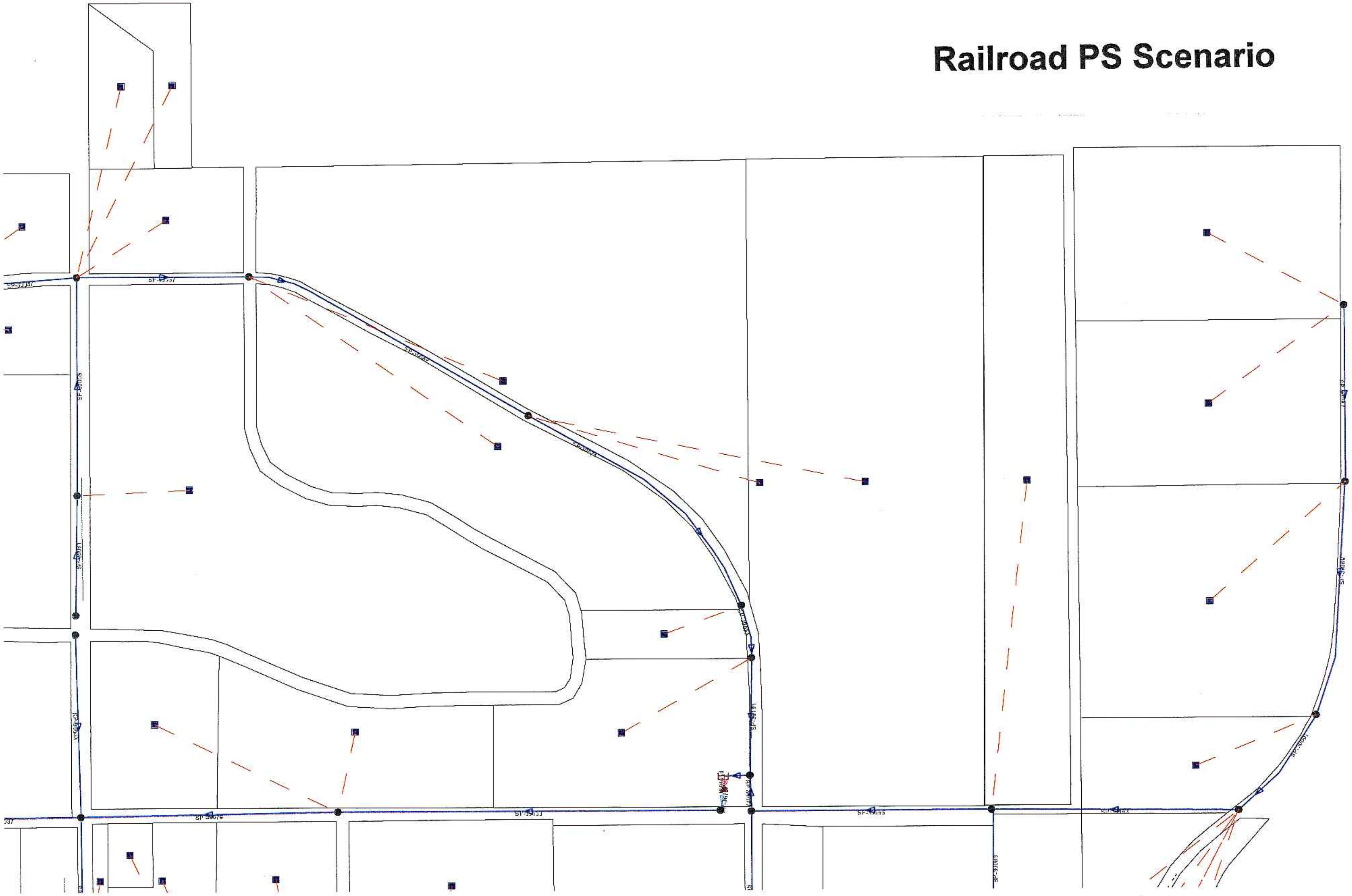
NW Corner

Railroad PS Scenario



NE Corner

Railroad PS Scenario

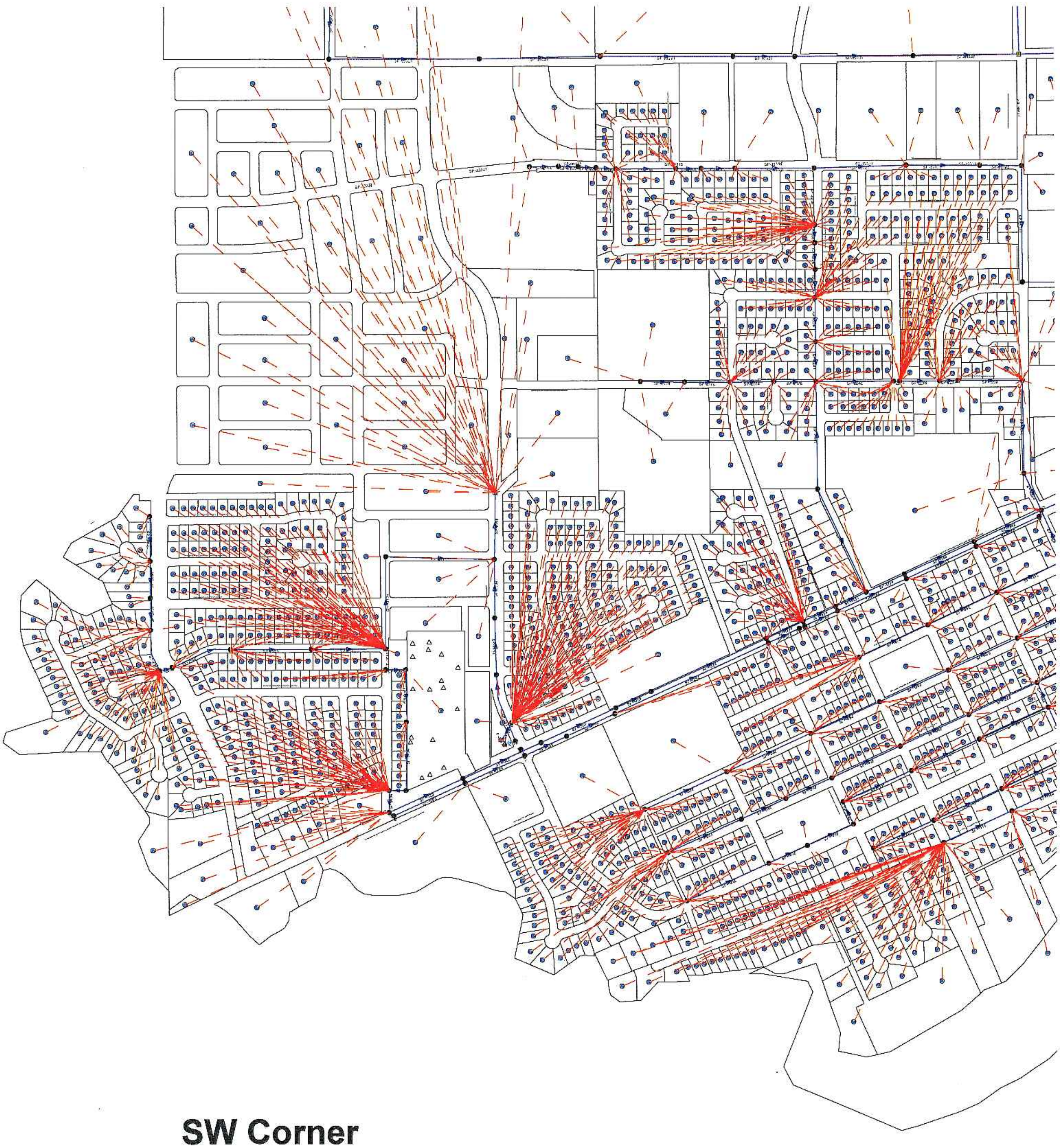


Attachment D

Load Allocation Figures: SWCCEPS Scenario

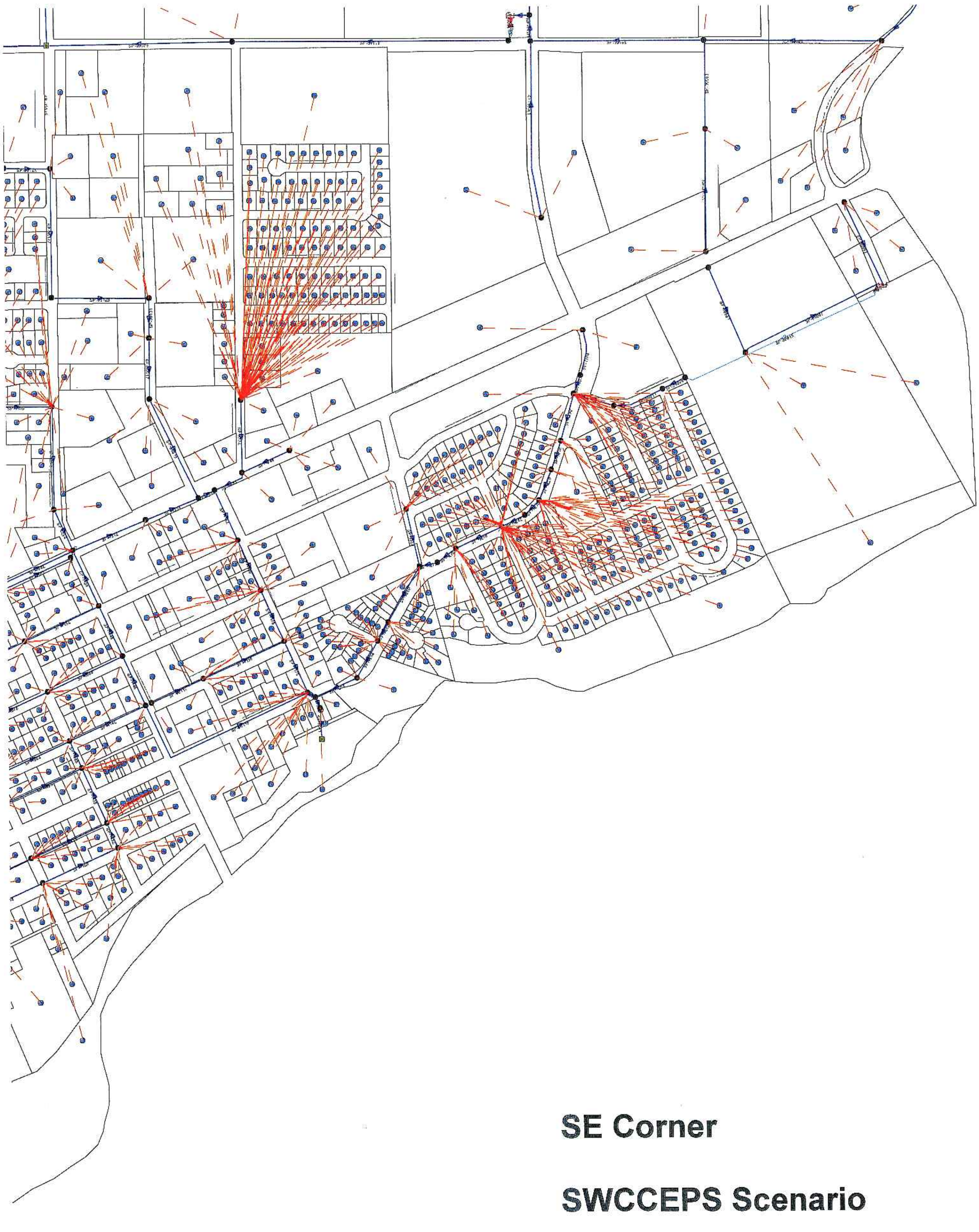
Load Allocation Overview

SWCCEPS Scenario



SW Corner

SWCCEPS Scenario

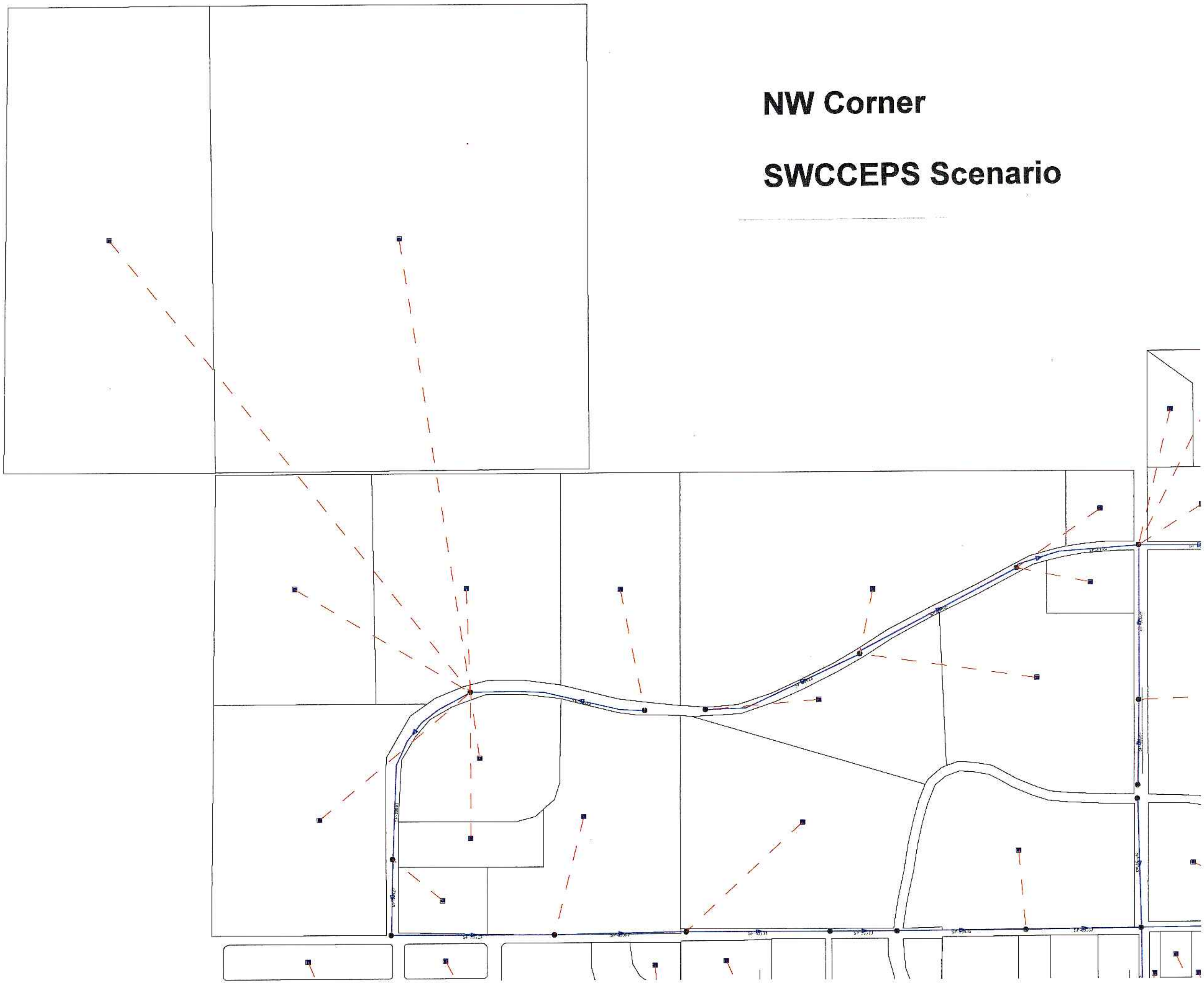


SE Corner

SWCCEPS Scenario

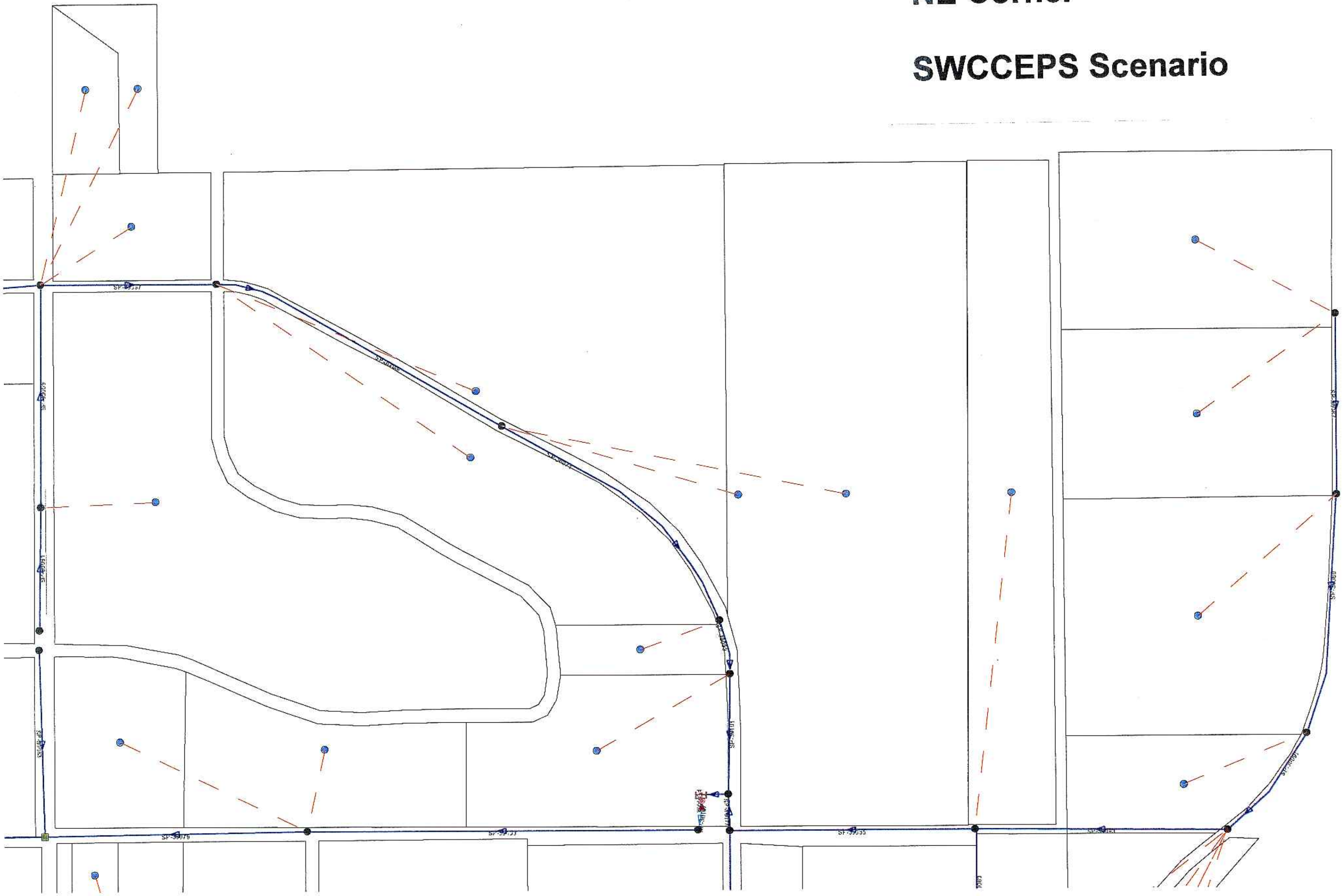
NW Corner

SWCCEPS Scenario



NE Corner

SWCCEPS Scenario



APPENDIX G

CD CONTAINING FINAL REPORT AND ALL APPENDICES

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